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AN EMPIRICAL ANALYSIS OF TAXATION AND STATE ECONOMIC GROWTH

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ABSTRACT

This study aims to empirically investigate the effect of taxes on economic growth in 45 states in the United States in the period 1960 to 1999. The literature review shows that both state level and country level studies result with two different answers on how taxes affect economic growth. Most of those studies show a negative impact, while some significant studies show a positive effect of taxes on economic growth. In overall, this study has shown that both initially and subsequently, taxes have a negative impact on state economic growth.

The problem addressed mostly in my study is the endogeneity of tax variables in the growth model. Further, the efforts to find instruments for tax variable are very crucial. I find that demographic, economic, and political structure variables are important for the determination of the change in state tax rates. Special for political issues, this empirical information supports the common knowledge that Democratic legislatures favor higher tax rates compared to Republicans, both in state and federal levels.

CHAPTER I

INTRODUCTION

I.1. Taxes and Economic Growth

The relationship between taxes and economic growth has long been a subject of interest to researchers and policymakers alike. After decades of research, the nature of the relationship is still unresolved. For example, Vedder (1995) finds that higher state and local taxes had negative effects on personal income growth from 1960 to 1993. A study by Becsi (1996) also shows that relative marginal tax rates had a significant negative effect on state growth over the period 1961 to 1992. On the other hand, a significant minority of studies [Quan and Beck (1987), Yu, Wallace, and Nardinelli (1991), and Chernick (1997)] report no evidence to support a hypothesis that state taxes lower economic growth--in fact they find some positive correlations between tax variables and economic growth.

Despite the large number of empirical studies on this subject,[1] there is still room for research to make a significant contribution because many methodological issues have not been addressed. Among these are: the causality of taxes and growth, finding instrumental variables for taxes, appropriate modeling of the error structure in cross-sectional time series data, and incorporation of insights from modern growth theory. I examine these aspects in my study to obtain a better analysis on the effects of taxes on state economic growth.

I empirically investigate the simultaneous path of how changes in state tax rates, political structures, and economic growth affect each other. I use cross-sectional, time-series data from U.S. states on economic, demographic, and political variables. The

[1] See chapter II for a more comprehensive literature review.

empirical model in my study allows for testing the validity of the inclusion of political structures as instrumental variables in the model. In other words, this study will fill the gaps in the literature by empirically addressing the endogeneity problem in the relationship between taxes and economic growth.

Relatively few of the empirical studies on state taxation and growth use cross-sectional, time-series data in their empirical analyses. Of these, none address the complexity of possible error structures beyond straight-forward groupwise heteroscedasticity. In contrast, I employ the cross-sectional, time-series approach with 5-year averaging to net out short-lived shocks and business cycles. I also conduct different estimation methods starting from ordinary least squares to two-stage least squares with panel corrected standard errors[2] to address the problem of serial correlation and cross-sectional correlation in my model. Therefore, I should be able to produce better estimates of the significance of tax effects on economic growth.

I.2. Possible Avenues by Which Taxes Could Affect Growth Rates

In theory, taxes levied by the government may have both positive and negative effects on economic growth. The positive effects of taxation can be explained by the fact that the value of economic resources and the ability to transform resources into output are greater to the degree that property is protected, roads and telecommunication infrastructures are provided, and domestic tranquility is insured. If growth were higher in these public sectors and tax revenues are used to finance these sectors, the higher taxes would be associated with higher economic growth.

The negative effects of taxation could be explained by the concept of "deadweight loss" of a tax. When a tax is imposed on a good, the tax reduces consumer

[2] See Beck and Katz (1995).

and producer surpluses by an amount that is greater than the tax revenue generated. The difference between the decrease in total consumer and producer surplus and total tax revenues is referred to as the deadweight loss of taxation. As the tax gets larger, the deadweight loss increases more proportionate to the tax increases.

Taxes are of interest not only because of their suspected effects on state economic performance, but also because they reflect the color of political views. It is common to acknowledge that Democrats favor higher tax rates compared to Republicans at both the state and federal levels. Studies by Poterba (1994, 1997), Beasley and Case (AER, 1995), (QJE, 1995), and Crain and Crain (1998) suggest the importance of political variables on state spending and expenditure decisions.

Of course, modern macroeconomic theory has been much concerned with the topic of economic growth. Exogenous growth theory predicts that states will grow at the same rate in steady-state. However, states may be characterized by different steady-state levels of income according to their respective saving rates, population growth rates, and other factors. States out of steady-state will grow at different rates. The further an economy is below its steady-state level, the faster the economy should grow. If states have similar steady-state levels of income, then this behavior will result in "convergence", as states that are located further from their steady-state levels "catch-up" to states that are further along their growth paths.

This prediction of convergence is based on the neoclassical growth model, specifically the Solow Growth model that is complemented by Baumol (1986), who introduces the notion of "conditional convergence". Studies by Barro and Sala-i-Martin (1991, 1992) and Carlino and Mills (1993) empirically find evidence of convergence among U.S. states. I will incorporate the insights of convergence theory in my growth model to provide some new evidences about the empirical relationship between state taxes and economic growth.

I.3. History of Tax Rates in the U.S.: 1960-1999[3]

Figure I.1 summarizes tax data from 48 of the 50 states (Alaska and Hawaii are omitted). The period 1960-1999 breaks down into three distinct periods with respect to state and local tax policy: (i) 1960-1973, (ii) 1973-1982, and (iii) 1982-1999. From 1960 to 1973, states experienced a steep increase in their state and local tax burdens. Overall Tax Burden, defined as the ratio of total state and local tax revenues over national Personal Income, rose from 9.5 percent to 11.8 percent. In other words, state and local Tax Burdens rose approximately 25 percent over a period of less than 15 years.

This trend of higher state and local taxes was primarily driven by two factors. The first was demographic. The children of the "baby boomers" started to enter the public school systems during this time period, putting a great strain on the primary and secondary school systems. The importance of this for state and local tax systems can be appreciated when one considers that more than half of total state and local spending was directed towards elementary and secondary education in the early 1960's.

A second factor was ideological. The economy as a whole was undergoing a general trend towards public sector expansion. As a result, all levels of government were expected to address problems that previously were considered outside their

[3] This discussion borrows heavily from Steven D. Gold, "Tax Reform, State", in Cordes, Ebel and Gravelle, editors, The Encyclopedia of Taxation and Tax Policy, pages 395-398, Washington, D.C.: The Urban Institute Press, 1999.

domain. As a result, state and local spending on higher education, health, and social services increased dramatically during this period.

This expansion of state and local services required increased funding sources. Between 1961 and 1971, 9 states adopted broad-based personal income taxes, 9 adopted corporate income taxes, and 10 adopted sales taxes. By way of comparison, no states adopted personal income taxes, and only 3 states adopted corporate income taxes, during the preceding period of 1947-1960.

The period 1973-1982 saw a major retrenchment in the size of state and local governments. Overall Tax Burden declined from 11.8 percent in 1973, to 10.2 percent in 1982. The steep increase of state and local tax rates during the 1960's and early 1970's provoked an anti-tax reaction, characterized by Proposition 13 in California (1978) and Proposition 2 1/2 in Massachusetts (1980), and the election of Ronald Reagan in 1980.

Property tax relief was a major political issue in the 1970's. This was evidenced by the fact that the ratio of property taxes to Personal Income fell from 4.6 percent in 1973 to 3.3 percent in 1982. Along with the overall decrease in property taxes, there occurred a shift towards greater centralization in tax collections. States began to take on a substantial share of the educational burden borne by localities. As well, states assumed a number of functions like welfare and Medicaid that previously had been carried out at the local level of government.

In addition, a number of states adopted tax indexation; that is, automatic "rebracketing" of income categories for tax purposes as inflation drove nominal incomes larger. This served to eliminate the automatic tax increases that accompanied inflation. Finally, a number of states adopted tax and spending limitation legislation. New Jersey was the first in this regard when it passed legislation in 1976 restricting the growth of state appropriations to the rate of increase of Personal Income. By 1982, a total of 19 states had adopted like legislation, limiting the growth of state expenditures to some function of inflation and/or population increases.

The period from 1982 to 1999 saw a gradual increase in state and local tax burdens, from 10.2 percent to 11.0 percent. The reasons for this increase are not clear. It may be due to the fact that a number of states restructured their income tax systems to make them more progressive. As state incomes grew in the 1990's, this would serve to cause revenues to grow even faster. Another factor may be the fact that many states broadened their income and sales tax bases. Whatever the reasons, this gradual increase has had the effect of returning state and local tax burdens to relatively high levels not seen since the late 1970's.

The appendix A presents figures reporting the time series of state and local Tax Burdens for each of the 48 states over the time period 1960-1999. On average, New York, Wyoming, Vermont, Wisconsin, and Minnesota are the five states with the highest tax rates during this time period (though Wyoming's high tax rate is mostly due to high severance taxes accompanied by an oil boom during the 1980's). New York's average state and local tax rates was14.2 percent. Wyoming had on average 13.2 percent of tax rates, while Vermont, Wisconsin, and Minnesota had average tax rates in the 12 percent range. Four southern states: Alabama, Tennessee, Missouri, and Virginia, and one non-southern state, New Hampshire, comprised the five states with the lowest tax rates during this period.

I.4. History of Growth Rates in the U.S.: 1960-1999

Figure I.2 represents the economic growth rates experienced by the 48 continental states in the US from 1960-1999. Two distinct periods are evident from the graph. The period from 1960 to 1980 shows a general decline in economic growth rates, as measured by both Real Personal Income and Real PCPI. In contrast, the period from 1980 to 1999 shows a gradual increase in economic growth.

A comparison of Figures I.1 and I.2 does not reveal a clear pattern between state and local Tax Burden and state economic growth. While the decline in economic growth in the first period coincides with a general period of increasing Tax Burdens, the increase in economic growth in the latter period also coincides with a period of gradually increasing Tax Burdens.

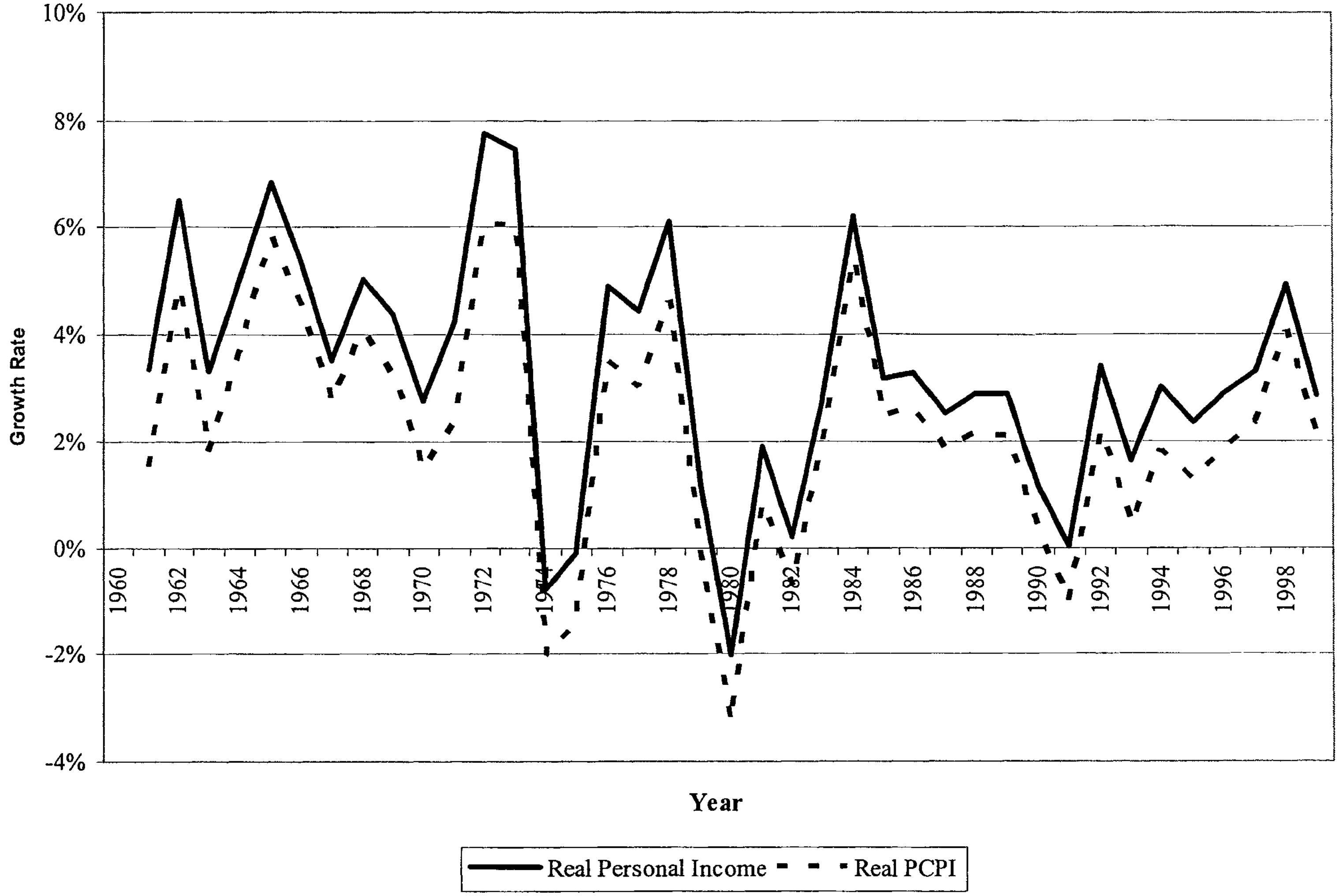
The Appendix reports time series of economic growth rates for each of the 48 continental states for the period 1960-1999. I find that Nevada, Arizona, Florida, Georgia, and Colorado were the 5 states with the highest growth rates in terms of both real Personal Income and real Per Capita Personal Income (PCPI). In contrast, New York, Iowa, Pennsylvania, Ohio, and West Virginia had the lowest growth rates.

I.5. Organization of this Study

This study proceeds as follows: Chapter II presents a review of the existing quantitative and qualitative empirical literature pertaining to the effect of taxes on economic growth. Chapter III presents my empirical model of taxes and economic growth. Further, it explains the specification methods that I will conduct to analyze the effects of state and local taxes. Chapter IV presents the essay, "Determinants of State Tax Rates". The main focus in this study, which is the analysis of tax effects on economic growth, is presented in Chapter V. Finally, Chapter VI summarizes my findings and suggests possible extensions for future research.

FIGURE I.1
Time Series of Ratio of State and Local Taxes to Personal Income ("Tax Burden") for the U.S.: 1960-1999

FIGURE I.2
Time Series of Growth Rates for Personal Income and Per Capital Personal Income (PCPI) for the U.S.: 1960-1999



CHAPTER II

LITERATURE REVIEW OF THE RELATIONSHIP BETWEEN TAXES AND ECONOMIC GROWTH

Empirical studies of the relationship between taxes and economic growth have produced inconsistent results. Most studies find a negative correlation between taxes and economic growth. However, a significant minority of studies reports no correlation, and some find evidence of a positive relationship.

This chapter reviews some of the important papers in this literature. The purpose of this review is to identify important data, specification, and estimation issues to guide my study. Previous studies can be divided into two groups: (i) studies that exploit differences within and across states in the U.S., and (ii) studies that exploit differences within and across countries. Most U.S. studies focus on the forty-eight, continental states. In contrast, there is great diversity in the composition of the data sets used by researchers using international data.

II.1. State-Level Analyses of the Relationship between Taxes and Economic Growth

Romans and Subrahmanyam (1979). Romans and Subrahmanyam (1979) are primarily interested in the effect of tax progressivity on state income growth. Using single equation, ordinary least squares (OLS) regression models, they employ three dependent variables: (i) growth rate in state personal income, (ii) growth rate in state non-agricultural employment, and (iii) growth rate in state per capita personal income. The data employed by Romans and Subrahmanyam consist of cross-sectional observations of the forty-eight contiguous states from 1964 to 1974.

Romans and Subrahmanyam use two groups of explanatory variables in their models, tax variables and control variables. Three tax variables are included: (i) tax progressivity, (ii) personal income tax rate, and (iii) business tax rate. Tax progressivity is shown to have a negative and significant effect on the growth rate in state personal income and state non-agricultural employment equations. The personal income tax rate is estimated to be insignificantly correlated with income growth; while business tax rate is positively and significantly related with economic growth

Romans and Subrahmanyam (1979) use the following control variables: (i) the ratio of non-agricultural to agricultural income, (ii) nonagricultural earnings, (iii) regional growth rate (minus the state's growth rate), and (iv) the percentage of state tax revenues going to transfer payments. Only the last two variables' coefficients are significant. The percentage of state revenues going to transfer payments is negatively significant affecting economic growth.

Romans and Subrahmanyam (1979) conclude that the level of state personal income taxes is unrelated to economic growth. On the other hand, the level of state business taxes is positively and significantly related to the growth. Tax progressivity is estimated to have a significant and negative effect on the growth.

The main data sources are the US Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business,* August 1975; and the US Department of Labor, *Manpower Report of the President*, 1970 and 1975.

Dye (1980). Dye (1980) investigates twenty-one potential determinants of economic growth. He examines simple bivariate relationships between alternative explanatory variables and three different measures of economic growth: (i) growth in personal income (1972-1976), (ii) growth in employment (1972-1976), and (iii) growth in value added by manufacturing (1972-1976). He groups the potential determinants of economic growth into two categories, tax variables and non-tax variables. The tax variables are further categorized into two groups: (i) tax burdens (including total tax burden, income tax burden, and sales tax burden); and (ii) business tax rates (including corporate taxes, worker income taxes, and executive income taxes). The non-tax variables include years since statehood, population size, per capita highway spending, measure of state revenues going to redistribution, a dummy variable to indicate whether a state has Right to Work legislation, and the percentage of the workforce that is unionized.

The author uses cross-sectional data consisting of observations from the fifty states over the period 1972-1976. The values for the explanatory variables are taken from 1970 or earlier.

For the purposes of this review, I will focus on the tax variables. Simple bivariate analyses find no evidence that any of the tax variables affect economic growth. The multivariate analyses also found little evidence that taxes matter. Only the growth of value added by manufacturing equation produced a significant tax result. In that equation, tax burden is negatively and significantly related to economic growth. On the other hand the results show that spending policies, especially per capita highway spending in the late 1960s, are closely associated with growth in income, employment and productivity in the 1970s. Age of settlement and stable government turn out to be influential determinants of economic growth. Unionization appears to have a slight negative effect on economic growth. Dye (1980) concludes that there is little correlation between taxes and economic growth.

Helms (1985). Helms (1985) is one of the first studies to use cross-sectional time series (panel) data. He is interested in identifying the separate, independent effects of taxes and spending on state per capita personal income. He uses a least squares dummy variable (LSDV) model that incorporates both state and time fixed effects. He also uses instrumental variable techniques to address endogeneity in one of the explanatory variables.

Helms (1985) uses the log of state personal income as the dependent variable. Tax variables include (i) the rate of property taxation and (ii) the rate of taxation from all other taxes. He also includes the rate of user fees. The nontax variables consist of (i) the state deficit rate, (ii) the federal source revenue rate, (iii) the health expenditures rate, (iv) the highway expenditures rate, (v) the rate of other expenditures (minus transfer payments), (vi) relative wages; (vii) the unionization rate; and (viii) the population density. All rates are calculated as a percent of state personal income.

The estimates suggest that increasing taxes or fees to finance transfer payments has a negative and significant effect on a state's personal income. The coefficients for many of the expenditure variables are positive and significant. Relative wages and unionization are negatively related to income, but have only marginal significance. Population density is estimated to have a negative and significant relationship with state income.

Helms's data consists of a panel of observations on the 48 continental states from 1965 to 1979, totaling 672 observations. Data on state personal income was obtained from the U.S. Census Bureau, *Survey of Current Business*. All tax and expenditure data were taken from the U.S. Census Bureau, *Government Finance* series. Relative wage is data was obtained from the *Handbook of Labor Statistics*. The unionization rate was taken from the *Directory of National Unions and Employee Organization.*

Canto and Webb (1987). Canto and Webb (1987) estimate individual time-series equations for each of the states to determine the relationship between taxes and economic growth. With the assumption of factor price equalization but possible inequality in per capita market incomes across states, they argue that, "divergences in market incomes across states is attributable, in part to the impact of state government fiscal policies on the supply of services of the immobile factor of production across states" (p. 187). Further, they state: ". . . the after-tax factor return and/or income of the immobile factor need not be equalized across states. Therefore, within this scenario, state and local fiscal policy can influence the income and after-tax return of the immobile factor across states" (p. 189). Their theoretical model allows markets to be in disequilibrium and looks like, but is different from, a partial adjustment model.

The dependent variable in Canto and Webb's study is the change in the log of state real per capita personal income. The tax variable is the change in the difference between the state tax rate and the national tax rate. Non-tax variables consist of the change in the log of national real per capita personal income; the change in the difference between state and national real per capita, non-transfer government spending; and national real per capita transfer spending.

Canto and Webb (1987) estimate separate models for each state. They use both OLS and 2SLS regression. The 2SLS regression is employed to address possible endogeneity in state taxes and transfers. They conclude that taxes have significant and negative effects on state real per capita personal income. The spending variables have insignificant coefficients.

Canto and Webb (1987) use observations on the forty-eight continental states from 1957-77. Data for federal government purchases of goods and services, transfer payments, tax revenues and personal incomes are taken directly from the *National Income Accounts*. State population values are obtained from the U.S. Census Bureau, *Current Population Reports*. State tax revenues, expenditures and transfer payments are collected from the US Department of Commerce, *States' Government Finances.* Finally, the states' personal income figures are obtained from the U.S. Bureau of Economic Analysis.

Quan and Beck (1987). Quan and Beck (1987) are primarily interested in estimating the effect of education expenditures on state economic growth. The dependent variables used in their empirical analysis are: (i) state relative to national personal income; (ii) state relative to national wage rate; and (iii) state relative to national employment in manufacturing sectors. The tax variables employed are current and lagged values of state tax burden relative to national tax burden, where tax revenues exclude severance taxes.

Quan and Helms also employ the following nontax variables: (i) current and lagged values of state relative to local education expenditures; (ii) current and lagged values of state relative to national higher education expenditures; (iii) current and lagged values of state relative to national non-welfare and non-education expenditures; (iv) lagged value of the log of relative average hourly earnings in manufacturing; and (v) state dummies to cover some potential effects of state specific variables that are not included in the model.

Quan and Beck's (1987) main finding is that education spending has a significant and positive effect on economic growth in the Northeast region, but a significantly negative effect in the Sunbelt. With respect to taxes, they find evidence that current and lagged values of state tax burden positively impact economic growth in both the Northeast and Sunbelt regions. These positive estimates occur in all model equations. However, the significance levels vary between the two subsamples. The estimate of tax variable is significant in the Northeast region but insignificant in the Sunbelt region. This significance result is consistent across all three equations.

Quan and Beck (1987) use cross-sectional and time series data for 32 states for the fiscal years 1964 through 1983. The equations' regressions are estimated on two sub-samples: the "Northeast", including 15 states in the New England, Mid-east, and Great Lakes regions (excluding Michigan); and the "Sunbelt", including 17 states in the Southeast and Southwest regions plus California. The main sources of data are the annual of *Government Finances*, *State Government Tax Collections* and the *Handbook of Labor Statistics.*

Vedder (1990). Vedder (1990) places the relationship between state and local taxes and economic growth within two models of public provision of services. The first model represents public provision of services using the theory of the firm/public choice approach. In this model, taxes are also viewed as potential income in the form of economic rents that can be appropriated by special interests (e.g. public employees, such as when compensation is paid to public employees beyond levels required by market forces). Vedder (1990) also sees the relationship between state and local taxes and economic growth being shaped by the Tiebout Hypothesis. According to this theory, individuals migrate in and out of localities based upon their preferences for government services.

The dependent variable in Vedder's (1990) study is the change in the log of state per capita personal income (1970-1980). Another model uses the same variable for the period from 1980 through 1988. As the tax variable, Vedder uses the change in state and local tax rate per $1,000 of personal income. He further employs four control variables: (i) the level of real per capita income at the beginning of the relevant time period; (ii) the proportion of the labor force belonging to labor unions at the beginning of the period; (iii) the age of the state as measured by years since statehood; and (iv) the proportion of personal income derived from the mining industry in 1980.

The results show that positive changes in state tax rates are negatively and significantly associated with lower state economic growth. The negative and significant relationship is estimated to be stronger in the 1980s than the 1970s. The continued negative correlation of tax changes to economic growth in both models strengthens confidence in the enduring nature of the tax-growth relationship.

Vedder (1990) employs cross-sectional data comprised of observed changes in the forty-eight continental states over two time periods: (i) 1970-1980, and (ii) 1980-1988. He does not list his data sources.

<u>Yu, Wallace, and Nardinelli (1991)</u>. Yu, Wallace, and Nardinelli (1991) test two hypotheses about state income growth. The first is income convergence, or the "catching

up" hypothesis. The second is that taxes discourage economic growth (the fiscal hypothesis).

They start their analysis with the assumption that states have different levels of physical capital, human resources, and technology. Mobility of capital and resources, in the long run, should cause the respective rates of return to equalize across states. However, equalization will be incomplete since there are permanent barriers between political jurisdictions. Alternatively, differences in fiscal environments between jurisdictions can lead to different growth rates: fiscal differences generate differences in growth rates due to different marginal tax rates. Yu, Wallace and Nardinelli (1991) address the question: What force is stronger in determining economic growth? (i) continuing adjustment to historical imbalance (convergence), or (ii) the effects of current fiscal policy decisions (taxation)?

Yu, Wallace and Nardinelli (1991) examine seven time periods: 1929 to 1985; 1929 to 1945; 1945 to 1957; 1957 to 1985; 1957 to 1965; 1965 to 1975; and 1975 to 1985. For each time period, they estimate a regression equation using the percentage change in real state per capita personal income as the dependent variable. For the tax variable, they use the ratio of state taxes to personal income. Other explanatory variables are real per capita personal income at the beginning of the period and the share of state expenditures at the beginning of period.

The catching up hypothesis predicts that the rate of growth of real per capita personal income will be inversely related to real per capita personal income at the beginning of period. Relatively poor states should grow faster than relatively wealthy states. The hypothesis of fiscal policy predicts that increased expenditures will generate increased economic growth; whereas increased taxes will hinder economic growth.

The results of Yu, Wallace, and Nardinelli's study (1991) show that catching up exerts a powerful influence on states' rates of growth. The coefficient signs of initial income are negative and statistically significant in all equations. Convergence appears to explain the long-run differences in state growth. In contrast, state fiscal policies are estimated not to be significant determinants of state growth rates. Initial expenditure performs poorly in every specification and time period. Likewise, there is little evidence to support the hypothesis that state taxes lower economic growth.

Yu, Wallace and Nardinelli (1991) use cross-sectional observations from all 50 states. Per capita personal income is taken from the U.S. Census Bureau. Date on state expenditures and taxes come from the U.S. Census Bureau, the Survey of Current Business, and other bureaus within the U.S. Department of Commerce.

Mullen and Williams (1994). A distinctive feature of the study by Mullen and Williams (1994) is its emphasis on marginal tax rates. Similar to other studies, Mullen and Williams incorporate convergence theory in their analysis. However, they argue that differences in fiscal and/or other public policies can generate permanent differences in the level of state per capita income. For example, some states may provide an economically attractive tax environment that is conducive to private investment.

Mullen and Williams (1994) develop an ad hoc empirical model, but claim that their model draws heavily upon the disequilibrium-adjustment models popularized in migration research. Mullen and Williams further explain that the disequilibrium-adjustment model is the model that "typically relates *changes* in the dependent variable over the period to *levels* of the explanatory variables at the beginning of period" (p. 691). There are three model specifications analyzed in their study: (i) a basic output and productivity equation, (ii) a basic output equation based upon the stock of public capital, and (iii) a basic output and productivity equation excluding outlier states.[4]

Dependent variables consist of the compound annual growth rate of (i) real Gross State Product, 1969-1986 and (ii) productivity growth (compound annual growth rate of real Gross State Product minus factor share-weighted growth in capita and labor inputs, 1969-1986). Explanatory variables consist of two categories: (i) tax variables, measuring both the average and marginal tax rates; and (ii) control variables, including initial real per capita income, the compound growth rate for the stock of public capital, the civilian labor force, and the private capital stock from 1969-1986.

Mullen and Williams (1994) are interested in determining whether taxes depress economic growth. They find that average tax rates are generally insignificant in all model specifications. On the other hand, marginal tax rates are found to be negatively and significantly related to economic growth. With respect to the nontax variables, their results lend support to the convergence hypothesis. States with higher initial levels of per capita income have significantly lower rates of economic growth. Labor force growth and increase in the stocks of both public and private capital are positively and significantly related to interstate economic growth. Further, states with tax rates that are high relative to neighboring states have slower rates of economic growth.

The data employed by Mullen and Williams (1994) consist of cross-sectional observations of the forty-eight, continental states 1969 through 1986 (except one model

[4] Arizona, Louisiana, New York, and South Dakota are found to have a substantial impact on a majority of the regression coefficients. So they are excluded to generate a better empirical result.

specification where four outlier states are excluded). Data on Gross State Product and per capita personal income are obtained from the U.S. Bureau of Economic Analysis. All tax and expenditure variables are gathered from the U.S. Census Bureau, *Government Finance Series,* The Advisory Commission on Intergovernmental Relation (ACIR), *State-Local Taxation Industrial Location,* and the Commerce Clearing House, *State Tax Handbook.* Last, the estimates of total private and total public capital stocks for individual states are taken from the Federal Reserve Bank of Boston.

Crown and Wheat (1995). Crown and Wheat (1995) are interested in identifying the factors responsible for the long-run convergence in state per capita incomes. Despite a fact that this study has no tax variable as explanatory variable, their study is included because of interesting demographic variables utilized in their model. Moreover, they focus on the differences between the fast-growing southern states and the slow-growth "industrial" states (hereafter non-southern). After 1950, the income gap between southern and non-southern states closed rapidly. The convergence process did not run smoothly from 1978 until 1987. During this time period, there was a farm crisis and a decline in energy prices that hurt the low-income states but helped the high-income states. However, convergence reappeared in the 1987-1993 period.

Crown and Wheat (1995) use percentage change in state per capita income as the dependent variable in their regression model. They employ cross-sectional data comprised of observations from the forty-eight continental states from 1950-1987. Their regression model consists of six explanatory variables: (i) the percentage change in the share of population living on farms from 1950 to 1987; (ii) an interaction term formed by multiplying a dummy variable for former slave states times the percentage change in the share of population living on farms from 1950 to 1987; (iii) an interaction term formed by multiplying a dummy variable for former non-slave states times the percentage change in the share of population living on tenant and sharecropper farms from 1950 to 1987; (iv) the percentage change in college graduates from 1950 to 1987; (v) the percentage change in median years of school completed from 1950 to 1987; (vi) the unemployment rate in 1987, and (vii) an interaction term formed by multiplying a dummy variable for former slave states times the 1950-1987 percentage change in the share of the black population.

Crown and Wheat (1995) conclude that changes in education and the farm-urban mix are the two strongest factors underlying changes in per capita income. They argue that a primary cause of income convergence is the collapse of sharecropping in the Southern states.

Becsi (1996). Like Crown and Wheat (1995), Becsi (1996) focuses on the phenomenal growth of the southern states. At issue is the role that state and local taxes may have contributed to this growth. According to Becsi (1996), taxes raise the costs and lower the returns of taxed activities. This creates incentives for individuals and businesses to engage in activities that are taxed at lower rates. The result is inefficient resource allocations and, ultimately, lower economic growth. Like Mullen and Williams (1994), Becsi (1996) argues that marginal tax rates are more important than average tax rates in affecting behavior, and hence, growth.

Becsi's dependent variable is the difference in average, annual growth rates of per capita personal income (PCPI) between the state and the nation (1961-1992). He employs two tax variables: (i) relative marginal tax rate, and (ii) a measure of relative tax progressivity (a kind of balanced budget condition). The one non-tax variable is the initial, relative PCPI. As discussed above, the initial PCPI is included to capture convergence effects in the data. Becsi's data consist of cross-sectional observations from all fifty states where data are averaged for the 1961-1992 period and initial PCPI is from 1960.

Becsi (1996) concludes that relative marginal tax rates are negatively and significantly related to relative state economic growth over the period 1961 to 1992. This suggests that economic policies that lower marginal taxes rates may result in increased long-term economic growth.

Chernick (1997). Chernick (1997) focuses on the relationship between state and local tax incidence and economic growth. He explains that the crucial determinant of tax incidence is the relationship between (i) the level of income and (ii) the demand for the public goods and service. The lower the income elasticity of demand for public goods and services, the less progressive the tax system. The greater the progressivity of a state's tax system, the greater the likelihood that mobile factors will migrate out of that state. According to this argument, increased tax progressivity will be negatively related to economic growth.

Chernick (1997) employs a cross-sectional time series dataset of forty-seven states (Hawaii, Alaska and Wyoming are excluded) from 1977 to 1997. The dependent variable is the growth rate in real PCPI measured over three separate time periods: 1977-1985, 1985-1989, and 1991-1993. The tax variables consist of (i) tax burden and (ii) a measure of tax progressivity. The nontax variables consist of: (i) initial relative PCPI in 1977; (ii) a measure of Aid to Families with Dependent Children Program (AFDC) benefits; (iii) the percentage of the population that is black; (iv) the percentage of the population that is young; (v) the percentage of the population that is elderly; (vi) the percentage of the labor force that is unionized; (vii) regional dummy variables (South, West, and North Central); and (viii) time period dummy variables (for 1985-1989 and 1991-1993).

The estimated results indicate that all tax variables employed have insignificant effects on the growth rate of real PCPI. Tax progressivity has a negative coefficient estimate while tax burden has a positive coefficient estimate. Chernick argues that one possible explanation for the insignificance of the tax variables is that inefficient tax structures respond to poor economic performance rapidly enough to prevent an observable effect on the economic base. Another possible reason is that tax structure is not responsive to changes in the tax base, at least in the short run period.

Yamarik (2000). Yamarik (2000) examines the effect of state tax policy on state economic growth using cross-sectional observations from forty-eight, continental states from 1977 to 1995. He distinguishes taxes paid on income, consumption and property: "the effects of taxation are disentangled by estimating disaggregate personal income, general sales and property tax rates" (p. 212). Yamarik predicts that higher income tax rates and property tax rates decrease the growth rate of employment, investment, and income. In contrast, he does not expect consumption or sales tax rates to affect growth, because it does not affect the return of capital like income and property taxation.

Yamarik (2000) employs the following dependent variables: (i) the average growth rate in Gross State Product (GSP); (ii) the average growth rate in GSP per worker (average productivity); (iii) the average growth rate in the labor quantity; and (iv) the average ratio or real investment to GSP. Tax variables consist of: (i) average tax rate with respect to GSP, (ii) average tax rate with respect to property, (iii) marginal tax rate with respect to GSP, (iv) marginal tax rate with respect to personal income, and (v) marginal tax rate with respect to general sales. For the control variables, Yamarik includes initial GSP per worker and the percentage of the population having college degrees.

Yamarik (2000) obtains mixed results with respect to the tax variables. The marginal tax rate with respect to GSP is estimated to have a positive coefficient in the GSP regression, but a negative coefficient when the dependent variable is the ratio of investment to GSP. On the other hand, the average tax rate enters negatively in both regressions. In contrast, the disaggregated tax rates are generally consistent with Yamarik's predictions. Accordingly, Yamarik (2000) concludes that disaggregated tax rates provide a better measure of tax distortions.

II.2. Country-Level Empirical Growth Studies

Grier and Tullock (1989) Grier and Tullock (1989) investigate various hypotheses about economic growth. They hypothesize that economic growth is determined by following variables. The first variable is initial conditions: from any starting point, countries that are behind in technology will grow faster relative to more advanced countries, due to diminishing returns to investment in a given technology. The second variable is population growth: labor force growth is hypothesized to have a direct effect on income growth. The third variable is inflation. Phillips curve models imply a permanent trade off between inflation and output; hence they predict a positive sign on inflation. On the other hand, anticipated inflation reduces capital accumulation and growth. In developing countries, inflation is often triggered by political crises that depress growth. This implies a negative coefficient on inflation. The fourth variable is variability in inflation. Previous studies have found that the variability of inflation is negatively correlated with GNP growth. Grier and Tullock (1989) measure the change in inflation by the sample standard deviation of inflation. The fifth variable is variability in income growth. Greater variability in income leads to higher savings, implying a positive relationship between income variance and economic growth. The last variable is size of government. Grier and Tullock (1989) hypothesize that a one-time change in government intervention will permanently change economic growth. Grier and Tullock (1989) construct their sample from two different groups of countries: the twenty-four members of the Organization for Economic Development and Cooperation (OECD), and eighty-nine countries from the rest of the world (ROW).

Grier and Tullock (1989) estimate three major differences between the two groups of countries: (i) In the OECD, the negative sign of initial per capita income confirms the convergence hypothesis. In the ROW, the positive sign of initial per capita income implies that richer countries grow faster than poorer countries. (ii) The standard deviation of population growth in OECD countries is smaller than one in ROW countries. (iii) Average inflation has no effect on the growth rates of OECD countries, but is negatively and significantly related to growth in the ROW. Government growth has a negative effect on economic growth in both samples.

Grier and Tullock (1989) employ a cross-sectional time series dataset of observations from 24 OECD countries and 89 ROW countries from 1951 to 1980. They average their data so that single observations consist of five-year averages. Their full sample consists of 500 observations. The data used in Grier and Tullock's study come from Summer and Heston dataset or Penn World Tables[5].

Koester and Kormendi (1989) Koester and Kormendi (1989) examine the impact of average and marginal tax rates on the level and the growth of economic activity. The study is motivated by supply-side hypotheses that predict that higher rates of taxation will inhibit economic activity and/or economic growth. Koester and Kormendi (1989) use two dependent variables in their regression model: (i) the growth rate in real GDP (1970-1979); and (ii) the level of per capita GDP (1980). Both average and marginal tax rates are included as explanatory variables, along with initial per capita GDP.

Koester and Kormendi (1989) estimate that marginal tax rates negatively and significantly affect the level of per capita GDP. The authors employ cross-sectional observations of sixty-three countries using averaged data from 1970 through 1979. Data on GDP, tax revenue and average tax rates come from the World Bank, *World Development Reports, 1982.*

Levine and Renelt (1992). Levine and Renelt (1992) use extreme-bounds analysis (EBA)[6] to test the robustness of coefficient estimates to alterations in the conditioning set of information. Accordingly, they provide evidence on the sensitivity of past studies to small alterations in the explanatory variables commonly used in growth studies.

Dependent variables used by Levine and Renelt (1992) are (i) the average annual growth rate of real per capita GDP (1960-1989), and (ii) the investment share (1960-1989). The explanatory variables consist of fifty-two variables measuring economic,

[5] The Table contains data on 30 variables for about 150 countries over the years 1950-92. It is built up through a set of sophisticated extrapolations from the successive benchmark studies, both through time and across space.
[6] Also see Leamer (1983) for detail explanation of this method.

political, and institutional factors. Included among fiscal policy variables are a wide variety of tax and expenditure variables, including the ratio of individual income tax receipts to GDP. They find that very few economic variables are robustly correlated with cross country growth rates or the ratio of investment expenditure to GDP.

Levine and Renelt (1992) use data from 119 countries from 1960 to 1989. Data come primarily from the World Bank and the International Monetary Fund. In addition, data from previous studies are also used to assess the reliability of the results.

Easterly and Rebelo (1993). The main focus of Easterly and Rebelo's study (1993) is to test the effect of fiscal policy variables on economic growth. They use standard data sources combined with newly created data for public investment. The neoclassical theory of endogenous growth provides the theoretical framework for their study.

The growth rate of real per capita GDP (1970-1988) is the dependent variable. Tax variables include various average and marginal tax rates. Non-tax variables include: (i) initial per capita GDP; (ii) initial primary enrollment; (iii) initial secondary enrollment; (iv) assassinations per million; (v) revolutions and coups; and (vi) war casualties per capita. Since data on cross country marginal tax rates are not observable, Easterly and Rebelo compute marginal income tax rates using four approaches: statutory tax rates, a fraction of revenue to GDP, income-weighted marginal tax, and regression results from regressing revenue from each type of tax on GDP.

Easterly and Rebelo (1993) conclude that the evidence for whether tax rates matter for economic growth is fragile. On the other hand, there is strong evidence that income affects tax rates. This evidence follows "Wagner's Law," which states that government expenditure is endogenous to economic development; as development proceeds there will be a long-run tendency for the public sector to grow relative to national income.[7]

Easterly and Rebelo (1993) use cross-sectional data consisting of observations from 105 countries over the period 1970-1988. They also utilize a cross-sectional, time series dataset consisting of 28 Latin American and OECD countries from 1870 through 1988. Data come primarily from the World Bank, *Government Financial Statistics*.

Engen and Skinner (1996). Engen and Skinner (1996) review existing studies on taxation and economic growth in order to estimate the growth impact of a major reform of the tax system in the U.S. They first examine the historical record of the U.S. economy for evidence of tax cut effects on economic growth. In the second step, they consider the evidence from large samples of countries. Finally, they evaluate the evidence from micro level studies of labor supply, investment demand, and productivity growth. Engen and Skinner's study does not undertake any original estimation work.

Engen and Skinner (1996) make a number of useful points. First, it reviews the major arguments relating taxation to economic growth. Second, it lists the econometric shortcomings of many studies. In particular it notes the problem of "*reverse causality*" saying that "....reverse causality is really the Achilles' heel of the typical cross-country regression. Nearly every variable on the right-hand side of the regression is suspect." (p. 630). Third, it estimates the following tax effect: a five percentage point decrease in marginal tax rates is estimated to increase annual growth by 0.28 percentage points in the short run and 0.22 percentage points in the long run. Finally, the composition of the tax

[7] The long-run tendency is caused by many factors such as a substitution of public for private sector activity, an increase in cultural and welfare expenditures by the state, and government intervention to manage and finance natural monopolies.

system is important. Countries with a more efficient tax administrative and enforcement system will be more likely to enjoy faster economic growth.

Sala-i-Martin (1997). Sala-i-Martin argue that the extreme bounds analysis (EBA) utilized by Levine and Renelt (1992) is a harsh criterion to determine the robustness of variables. He estimates two million regressions in order to have a better determination of variables' robustness. Sala-i-Martin (1997) studies the robustness of 59 variables, including variables that represent monetary policy, political policies, and institutional indicators. Data for all variables employed in Sala-i-Martin's study are taken from the World Bank Research Department's website.

The results of the study by Sala-i-Martin (1997) show that 22 out of the 59 variables tested appear to be significantly related to economic growth. In contrast, the EBA criterion leads to the determination that only one variable coefficient is significant and robust. In comparing these two results, Sala-i-Martin concludes: "the picture emerging from the empirical growth literature is not the pessimistic, 'nothing is robust' result obtained with extreme bound analysis. Instead, a substantial number of variables can be found to be strongly related to growth" (p.182).

Mendoza, Milesi-Feretti, and Asea (1997). The main point of a study by Mendoza, Milesi-Feretti, and Asea (1997) is to test the effect of tax policy on economic growth. The authors base their empirical model on endogenous growth theory, which is driven by the accumulation of factors of production (human and physical capital) and "Constant Return to Scale" technologies.

Mendoza, Milesi-Feretti, and Asea (1997) use the growth rate of per capita real GDP for their dependent variable. Tax variables include: (i) the GDP share of government purchases which can be interpreted as an overall tax rate; (ii) the tax rate on labor; (iii) the tax rate on consumption; and (iv) the tax rate on personal income. The nontax variables consist of the following: (i) initial per capita real GDP; (ii) private investment rate; (iii) changes in "terms of trade"; (iv) secondary school enrollments; and (v) time effect dummies.

Mendoza, Milesi-Feretti, and Asea (1997) find that taxes have negligible growth effects. There is no evidence that tax rates affect the income growth in the long run. In contrast, there is some evidence that taxes have transitional effects that disappear over time. They also recognize the importance of correcting for the endogeneity of tax rates with respect to income.

Mendoza, Milesi-Feretti, and Asea (1997) employ cross-sectional and time series data consisting of observations of eighteen OECD countries from 1966 until 1990. Using five-year averaging procedures, they obtain a total of ninety observations. Data comes primarily from OECD, *Revenue Statistics* (1990) and *National Accounts: Volume II, Detailed Tables* (1991).

Temple (1999). Temple (1999) reviews recent empirical studies of economic growth. He identifies five topics of concern. The first is "Parameter heterogeneity": Empirical studies on economic growth generally lump together countries that differ widely on social, political, and institutional dimensions. This problem is likely to be more severe in cross-sectional studies. The second is "Model uncertainty": Levine and Renelt (1992) have shown that coefficient results are not robust to alternative variable specifications. The third is "Endogeneity": To avoid simultaneity, many researches often make use of initial values and omit important variables from the model. The fourth is "Error correlation and regional spillovers": The disturbances in cross-section growth regressions may not be independently distributed. To fix this problem, many researchers often use regional dummies to add to the explanatory power. However, the inclusion of regional dummies does not address random error correlations. The last is problems inherent in cross-sectional and time series data: Business cycle effects confront researchers with difficult choices when selecting time intervals to study growth. The relative advantages of annual data, five-year averages, or ten-year averages are not well understood. Despite these problems, the use of panel data approaches, together with tests for parameter heterogeneity, can successfully address many of the objections raised to cross-sectional empirical studies.

Kneller, Bleaney, and Gemmell (1999). Kneller, Bleaney, and Gemmel (1999) test the effect of fiscal policy on economic growth. For the dependent variable, the authors use per capita growth in GDP. Nontax variables include: (i) initial per capita GDP; (ii) investment; (iii) labor force growth; (iv) productive expenditures; (v) other revenues; (vi) other expenditures; (vii) "lending minus repayments"; (viii) budget surplus; (ix) country dummies; and (x) time dummies.

Kneller, Bleaney, and Gemmell (1999) find that tax coefficients have a significantly strong negative impact on economic growth. They also report evidence that fiscal policy has effects that last longer than five years. They address a number of econometric concerns. However, they find that their results are robust to the endogeneity problem, sample selection, and regression specification.

Kneller, Bleaney, and Gemmel (1999) use a cross-sectional, time series dataset consisting of twenty-two OECD countries from 1970 to 1995. Data are averaged over five-year periods to produce a total of 110 observations. Fiscal variables are collected from the IMF, *Government Financial Statistics Yearbook.* Annual data on real per capita GDP, investment rate, and labor force are taken from the World Bank CDROM.

Padovani and Galli (2001). Padovani and Galli (2001) test the effect of tax rates on cross-country economic growth. The authors attempt to improve on Koester and Kormendi (1989), Levine and Renelt (1992), and Grier and Tullock (1989) by producing longer time series of marginal tax rates and including a level and a slope dummy to capture the effects of tax reforms on tax rates. Padovani and Galli (2001) also check the robustness of their estimates using extreme bound analysis (EBA).

Padovani and Galli (2001) use the growth rate in GDP as their dependent variable. Explanatory tax variables consist of the marginal tax rate and the government consumption share of GDP (as a measure of the average tax rate). Nontax control variables include: (i) initial GDP; (ii) population growth; (iii) investment in physical capital; (iv) educational attainment; (v) mean of inflation; and (vi) terms of trade. There are no time effect and country effect dummy variables in the model.

Padovani and Galli (2001) estimate that increased marginal tax rates are associated with lower economic growth. This result appears robust to change in model specification. Their sample is a cross-sectional and time series dataset consisting of twenty-three OECD countries from 1951 to 1990. Using ten-year averaging, they obtain a total of ninety-two observations.

Foelster and Henrekson (2001). Foelster and Henrekson (2001) restrict their analysis of taxes and economic growth to rich countries. They argue that rich countries share many unobserved characteristics that non-rich countries do not possess.

Accordingly, including of non-rich countries results in omitted variable bias that distorts the estimation of tax effects. For their sample, the authors select twenty-three OECD countries from 1970 to 1995. The authors engage in extensive robustness testing, including Leamer's EBA.

The authors use the growth rate in per capita GDP for their dependent variable. The tax variable is average tax rate, measured by total taxes as a share of GDP. The nontax variables consist of: (i) initial per capita GDP; (ii) investment as a share of GDP; (iii) growth rate of the labor force; (iv) growth rate of average years of schooling; (v) country dummies; and (vi) time dummies. They average data over five-year periods.

Foelster and Henrekson (2001) conclude that taxes are negatively and significantly related to economic growth. This finding is found to be robust with respect to sample selection. The result is maintained even when the sample is extended to include non-OECD countries.

Bleaney and Nishiyama (2002). Bleaney and Nishiyama (2002) have as their ambitious goal to develop the "best" empirical model of economic growth and establish a benchmark model. They start the analysis by comparing models from previous studies. They are motivated by criticisms of extreme bounds analysis (EBA). EBA is shown to underestimate coefficient robustness. It rejects too many variables as fragile, even when they are part of the true data-generating process.

Bleaney and Nishiyama (2002) include twenty-six variables in their empirical analysis. Their sample consists of observations from 138 countries from 1965 to 1990. Changes in human capital, institutions, specialization in primary products, and terms of trade are estimated to be important determinants of growth. They also report evidence of significant nonlinearity in the relationship between initial income levels and growth.

II.3. What Can We Learn from This Literature Review?

Surprisingly, there are relatively few studies of the effect of taxes on state economic growth that employ cross-sectional time series analysis. Of the state-level studies surveyed above, only Helms (1985), Quan and Helms (1987), and Chernick (1997) use cross-sectional time series analysis. Further, of these three, only Helms (1985) uses a continuous time series and has a broad coverage of states. However, none of these studies use the five-year cross sectional, time series approach that Grier and Tullock (1989) pioneered in their study of cross-country growth differences, which has become so popular nowadays. Five-year averaging has the advantage of netting out short-lived shocks that can spuriously generate correlations in the data, and disguise true correlations.

International growth studies that estimate the effect of taxes while employing cross-sectional, time series data are: (i) Grier and Tullock (1989)--if one counts the variable "mean growth of government share of GDP" as a tax variable; (ii) Mendoza, Milesi-Feretti, and Asea (1997); (iii) Kneller, Bleaney, and Gemmel (1999); (iv) Bleaney, Gemmel, and Kneller (2001); (v) Padovano and Galli (2001); and (vi) Foelster and Henrekson (2001).

Tax variables in the state level studies are shown to have ambiguous effects on the economic growth. Romans and Subrahmanyam (1979) show that business tax rate has a significantly positive effect on economic growth while tax progressivity has a significantly negative effect. Chernick also finds that Tax progressivity has a negative effect. In contrast, he estimates a positive coefficient sign for tax burden though it is significant in only some of the regressions. Table 2.1 summarizes the estimated effects of tax variables on income growth in the state level studies.

On the other hand, tax variables in international level studies are generally shown to have a negative effect on economic growth, as seen in Table 2.2. Mendoza, Milesi-Feretti, and Asea (1997) show that all taxes except consumption taxes have negative and significant effects on economic growth. Distortionary taxes have a negative effect on growth while non-distortionary taxes have a positive but insignificant effect according to Kneller, Bleaney, and Gemmel's studies (1999 and 2001). It is worth noting that only international studies (iii), (iv), and (v) use country *and* time dummies to obtain better estimate results on taxes effects.

There is considerable concern with the endogeneity problem: Easterly and Rebelo (1993) argue that fiscal policy is free from the endogeneity problem when they control income by adding aid revenue for all countries. Additionally, they argue that, in the long run, population level is more responsible for variations in fiscal structure; hence the endogeneity problem can be avoided if one controls for population levels. Mendoza, Milesi-Feretti, and Asea (1997) and Bleaney, Gemmel, and Kneller (2001) use instrumental variable techniques to address endogeneity in their model. Temple (1999) reviews previous approaches to the endogeneity problem and concludes that none are likely to eliminate the problem.

Among state and country-level growth studies, Foelster and Henrekson (2001) and Padovano and Galli (2001) are the only two that correct for the fact that observations may not be independent and identically distributed (*iid*). Temple (1999) notes that disturbances in cross section growth studies using regional dummies may not also be *iid* because of the possibility of spatial correlation in the disturbances. Efforts to adjust for spatial correlation can raise formidable statistical problems. Temple concludes that the standard error in most cross-section growth studies regressions "should be treated with a certain degree of mistrust" (p. 131).

A number of studies recognize a potential lack of robustness in their estimates. Levine and Renelt (1997) find that almost all results from existing studies are not robust. Sala-I-Martin (1997) attempts to use a "less-extreme test" (compared to the extreme bound analysis (EBA) of Levine and Renelt) by running 2 million regressions in order to assign some level of confidence to each of the variables used in the existing growth studies. Sala-I-Martin finds that, contrary to EBA analyses, there are many variables that are robustly related to growth. Kneller, Bleaney and Gemmel (1999), Foelster and Henrekson (2001), and Bleaney and Nishiyama (2002) investigate and test the robustness of their estimation results, most frequently using extreme bound analysis (EBA). All these studies find cases of non-robustness in some of the variables. Again, Temple (1999) has critiques: He notes tests of robustness have their own problems, including but not limited to endogeneity and measurement errors. Moreover, Temple emphasizes that the EBA tests and the like pay too much attention to statistical significance, and not enough to the real economic problems the studies are designed to address.

Bleaney, Gemmel, and Kneller (2001) claim that government fiscal effects may have both short- and long run effects. The authors do Wald χ^2 tests to find the appropriate lag length of fiscal variables. They find evidence that fiscal effects last eight years.

Previous studies identify at least five different ways that taxes might affect economic growth. The first is that higher taxes on corporate and individual income can discourage investment. Second, taxes may reduce labor supply growth by discouraging labor force participation. Third, tax policy may attenuate research and development (R&D) and development of "high-tech" industries. Fourth, tax policies can influence the marginal productivity of capital by encouraging businesses to move from heavily-taxed sectors with high level of productivity to lesser-taxed sectors with lower productivity. Finally, heavy taxation on labor supply will discourage workers from working in sectors with high social productivity. With lower labor and capital productivity, economic growth will be diminished.

Table II.1: The Effects of Fiscal/Tax Variables on Economic Growth: States' Studies

States' Studies	Fiscal/Tax Variable	Sign	Significant
Romans and Subrahmanyam (1979)	• Tax Progressivity • Personal income tax rate • Business tax rate	- + +	Yes No Yes
Dye (1980)	• Total tax burdens • Income tax burden • Sales tax burden • Business tax rates • Workers' income taxes • Executive income taxes	+ + +/- - - -	Sometimes No No No No No
Helms (1985)	• Property tax • Other taxes	- -	Sometimes Sometimes
Canto & Webb (1987)	• Change in state relative to national tax burden	-	Yes
Quan and Beck (1987)	• Current state relative to national tax burden • Lagged state relative to national tax burden	+ +	Sometimes Sometimes
Vedder (1990)	• Change in state and local tax burden	-	Yes
Yu, Wallace, and Nardinelli	• Tax burden	+/-	Sometimes
Mullen and Williams (1994)	• Average tax rates • Marginal tax rate	- -	No Yes
Becsi (1995)	• Relative marginal tax rate • Relative tax progressivity	- -	Yes Sometimes
Chernick (1997)	• Tax burden • Tax progressivity	+ -	Sometimes Sometimes
Yamarik (2000)	• Tax burden with respect to GSP • Tax burden with respect to property • marginal tax rate with respect to GSP • marginal tax rate with respect to personal income • marginal tax rate with respect to general sales	- - +/- - +/-	Sometimes Yes Sometimes Sometimes Sometimes

Table II.2: The Effects of Fiscal/Tax Variables on Economic Growth: Countries' Studies

Countries' Studies	Fiscal/Tax Variable	Sign	Significant
Grier and Tullock (1989)	• Mean growth of government share of GDP	-	Yes
Mendoza, Milesi-Feretti, and Asea (1997)	• Tax on Consumption • Tax on Labor Income • Tax on Capital Income • The ratio of Individual Income Tax Revenue to GDP	+ - - -	Yes Yes No No
Kneller, Bleaney, and Gemmel (1999)	• Distortionary Tax • Non-Distortionary Tax	- +	Yes No
Bleaney, Gemmel, and Kneller (2001)	• Distortionary Taxation	-	Yes
Padovano and Galli (2001)	• Marginal Tax Rate	-	Yes
Foelster and Henrekson (2001)	• Tax burden with respect to GDP • The ratio of government expenditure to GDP	- -	Yes Yes

CHAPTER III

GENERAL DESCRIPTION OF THE EMPIRICAL APPROACH

This chapter describes my empirical approach for examining the effect of taxation on state economic growth. I first discuss the general specification of the including the dependent and explanatory variables employed in the model. Then, I move on to briefly discuss the econometric issues associated with estimating the model. Finally, I discuss my step-by step estimation plans, starting from ordinary least squares with dummy variables to the two-stage least squares with panel-corrected standard errors.

III.1. Model of Economic Growth and Taxation

My empirical work will estimate the following model of taxation and economic growth, using a cross-sectional, time series data set of 45 states with eight observations per state from 1964 to 1999:

$$\Delta Y_{s,t} \equiv Y_{s,t} - Y_{s,t-j} = \beta_0 + \beta_1 Y_{s,t-j} + \beta_2 \Delta TR_{s,t} + \beta_3 TR_{s,t-j} + \sum_{i=4}^{k} \beta_i X^i_{s,t-j} + \mu_s + \lambda_t + \varepsilon_{s,t}$$

where $s = 1,2,\ldots, 48$; $t = 1964, 1969, 1974,\ldots, 1999$; and $j = 4$.

The dependent variable is change in the log of state real personal income ($\Delta Y_{s,t}$), which is what most of the literature uses to measure economic growth. The lagged value of log real personal income at the beginning of the five year period ($Y_{s,t-j}$) is included as an explanatory variable because of neoclassical growth theory. When applied to states, this theory predicts that states will "converge" to the same steady state growth path. The states that are furthest from their steady states will grow the fastest. The implication is that, ceteris paribus, states with lower initial personal income levels will grow faster than ones with higher initial personal income levels.

The next explanatory variables are the ***Change in Tax Rates*** during the five-year period ($\Delta TR_{s,t}$) and the value of state tax rates at the beginning of the five-year period-***Initial Tax Rates*** ($TR_{s,t-j}$). Tax rate in this study is referred to as "Tax Burden" and is defined as the percentage of the level of state and local taxes to state personal income. An unresolved question in the taxes and economic growth literature is: Is it the change in tax rates or the level of tax rates that affects economic growth? While most empirical taxation and growth studies use the level of taxes, some important studies use changes in tax rates in their analyses (Vedder, 1990; Grier and Tullock, 1989). For this study, both the changes in tax rates and the level of tax rates are included; however, the level variable used is the value of state tax rates at the beginning of the five-year period ($TR_{s,t-j}$). The use of the initial levels follows for all the explanatory variables, except the change in tax rates ($\Delta TR_{s,t}$) which is contemporaneous. Statistically, the use of the initial levels is designed to avoid potential problems with endogeneity in the model of this study.

Other explanatory variables ($X^{i}_{s,t-j}$) are used to control for other factors that may explain state growth rates. Neoclassical growth theory allows the possibility that states may have different steady-state growth rates. I rely on the empirical literature for guidance in the selection of variables. These variables are also employed as control variables[8] to rule out alternative explanations of economic growth; also included are the variables that have been found important in previous research. They will be entered with their initial values or values at the beginning of the respective five-year periods.

State fixed effects (μ_s) are included in the model to capture the influence of omitted variables containing substantially state-specific characteristics. These omitted

[8] In general, control variables include any plausible alternative cause or influence. In statistical terms, control variables are variables one would like to hold constant so one can examine the effect of some particular independent variables.

variables may explain state growth rates and may be correlated with the tax variables. Another reason of including the state fixed effects in the growth model is also to capture the noise of endogenous growth theory[9] in which a state has its own specific characteristics such as technological factors that will allow this state to have a different growth and economic path from other states. Finally, time fixed effects (λ_t) are included to capture national shocks that affect state personal income due to secular growth, business cycles, population trends, federal and fiscal policies, etc. Correlations between movements in these tax rates and national shocks to state personal income could generate spurious correlation between tax rates and state personal income if the national shock effects on personal income are not controlled.

III.2. Econometric Issues

The specification of the model above raises immediate concerns about the endogeneity of the ***Change in Tax Rates*** during the five-year period ($\Delta TR_{s,t}$). In particular, there is concern that states may raise (lower) taxes during times of recession (growth). If this is the case, then causation would run from the dependent variable to the explanatory variable, resulting in inconsistent estimates of tax effects. This concern with endogeneity is common in economic growth studies. Engen and Skinner (1996) write: "...reverse causality is really the Achilles' heel of the typical [growth] regression. Nearly every variable on the right-hand side of the regression is suspect" (p. 630). I take two measures to circumvent the endogeneity problem in the model.

[9] The endogenous growth theory (Romer, 1994) differs from a "Solow Growth" model (exogenous growth theory) primarily in the lack of diminishing returns to capital. Technology is no longer assumed to be exogenous to the economy and the growth process. This assumption leads to the debates about what drives technological change and whether it contributes to convergence or not.

First, I use two-stage least squares (2LS) to address problems of endogeneity with the ***Change in Tax Rate*** variable. I employ political representation variables such as ADA (American for Democrat Action) scores, and strength of Democratic and Republican Party variables as instrumental variables. These instruments are expected to be correlated with tax rates but uncorrelated with economic growth. I will check the suitability of my instrumental variables by (i) using an F-test to check for the joint significance of the political variables in the first-stage regression (cf. Bound, Jaeger, and Baker; 1995); (ii) using a Hausman test to test (over-identifying restrictions) for the exogeneity of the instruments (cf. Caselli, Esquivel, and Lefort; 1996); and (iii) conduct a Bollen test[10] to check whether the instruments which over-identify the model are valid in the general model specification.

The second way to deal with endogeneity is using initial values for all non-tax explanatory variables. Initial values are the values at the beginning of the respective five-year period. The use of initial values for explanatory variables will eliminate the problem caused by endogeneity for these particular variables.

Another econometric issue is non-spherical error terms in the model of economic growth and taxation. If one relaxes the assumption that $\mathrm{Var}(\varepsilon) = \sigma^2 I_n$ and assumes that $\mathrm{Var}(\varepsilon) = \Sigma$, where Σ is a general symmetric positive definite matrix, the result is the case of non-spherical error terms or disturbances. Consequently, the ordinary least squares (OLS) estimators are still unbiased but are no longer BLUE, and efficiency is lost. Possible sources of the non-spherical error terms in the econometric model are: (i) serial correlation; (ii); group-wise heteroskedasticity and (iii) cross-sectional correlation.

[10] Bollen (1996) proposes this as a test of whether the general model specification and the instruments are valid. It is similar to a chi-squared test for overall significance. The test checks whether the extra variables that over-identify the model are valid for the specification

Serial correlation (also called autocorrelation) is the correlation of a variable with itself over successive time intervals. This problem occurs mostly in time-series data. Serial correlation will not affect the unbiasedness or consistency of OLS estimators, but it will affect their efficiency. With positive serial correlation, the OLS estimates of the standard errors will be below the true standard errors. This leads to the conclusion that the parameter estimates are more precise than they really are.

The reason to have group-wise heteroscedasticity in the model of economic growth and taxation is that states differ from one to another. For example, states dependent on volatile industries like high tech manufacturing, agriculture, or tourism, may not have higher average economic growth than other states, but will have greater volatility in their economic growth. The group-wise heteroscedasticity is easily incorporated and moreover, amenable to feasible generalized least squares (FGLS) estimation.

Another error structure issue is cross-sectional correlation. State economies may be linked either due to geographical proximity, or because inputs and outputs from different states may be complements or substitutes. This generates correlation between the state economies. This correlation (called cross-sectional correlation) is a problem for the estimation of the model of economic growth and taxation. The standard errors from OLS estimation will be inconsistent. Unfortunately, the usual prescription for this problem, feasible GLS estimation (FGLS), cannot be applied in my study because the number of time periods observations in my sample is less than the number of cross-sections observations ($t < s$). In this case, the corresponding covariance matrix is not full rank, rendering FGLS inapplicable. Accordingly, I use the method of Beck and Katz

(1995), which is the method of panel corrected standard error (PCSE), to adjust for cross-sectional correlation. This method uses OLS to generate coefficient estimates, but uses the estimated covariance matrix to calculate standard errors. The Monte Carlo work of Beck and Katz (1995) found that this approach produced relatively low mean squares error (MSE) estimates, while generating reliable standard error estimates.

III.3. Estimation Plan

The samples for this study consist of a cross sectional/time series dataset on 45 states (Alaska, Hawaii, Nebraska, Minnesota, and Wyoming are excluded). Like many other studies, I exclude Alaska and Hawaii because their economies are so different than the continental states. Nebraska and Minnesota are excluded from the analysis because of missing information in political party variables; political party variables are needed as instrumental variables to perform 2SLS based estimation methods. Wyoming is omitted because it is the only continental state whose state tax rate is heavily dependent on severance taxes: During the late 1970s and 1980s when the state experienced an oil boom and bust, Wyoming's calculated tax rate changed dramatically in response to rising/falling severance taxes.

The sample period commence with data from 1960, the initial year for which I could obtain a complete and consistent series of all variables. The sample period ends with data from 1999, the most recent year for which all data are available.

My sample contains eight time periods: (1) 1960-1964, (2) 1965-1969, (3) 1970-1974, (4) 1975-1979, (5) 1980-1984, (6) 1985-1989, (7) 1990-1994, and (8) 1995-1999. With 45 states, the total number of observations is 360. I assume the conditions of serial correlation, group-wise heteroskedasticity, and cross-sectional correlation in the model of economic growth and taxation.

The following paragraphs present verbal descriptions, along with a discussion of the advantages and disadvantages of the estimator methods employed in the model of economic growth and taxation analysis. These paragraphs also show the abbreviations that will be used to refer to these estimators in the remainder of the paper.

Ordinary Least Squares (OLS)

The first step of estimation in this study is model estimation using ordinary least squares with dummy variables. This is nothing more than conventional OLS with state and time dummy variables included (μ_s' s and λ_s's). It is worth noting that OLS is optimal for cross-sectional and time series models if the errors are spherical. In other words, it is important to assume that all the error processes in cross-sectional and time series models is homoscedastic, and also free from the problem of autocorrelation and cross-sectional correlation. The assumptions of homoscedasticity and spherical errors are too strong to be applied in the cross-sectional and time series models like the model of economic growth and taxation in this study. Beck and Katz (1995) write: "Most analysts, however, are not willing to accept the assumption of spherical errors for time series and cross-sectional models" (p. 636).

Ordinary Least Squares with Heteroscedastic Consistent Standard Errors (OLS-HCSE)

The second step is to estimate the model using Ordinary Least Squaress (OLS), but with robust standard errors (White standard errors). This relaxes the assumption of homoscedasticity. Trying to transform the data to correct heteroskedasticity can lead to problems if the assumption of the exact form of heteroskedasticity turns out to be wrong.

In this case, it may be better to accept the (inefficient) OLS coefficient estimates, but calculate consistent standard errors (given the maintained assumption of heteroskedasticity).

Ordinary Least Squares with Panel-Corrected Standard Errors (OLS-PCSE)

To address the full complexity of the error structure assumed to exist in my data set, I estimate the model using OLS with panel-corrected standard errors pioneered by Beck and Katz (1995). Beck and Katz (1995) show (*via* Monte Carlo experiments) that the efficiency gains from cross-sectional correlation correction are typically small, while standard-error bias is relatively large. Accordingly, Beck and Katz (1995) suggest estimating standard errors according to a robust procedure that incorporates potential cross-sectional correlation information into the coefficient variance-covariance matrix without adjusting the coefficient estimate.

Beck and Katz (1995) show that this procedure (Panel-Corrected Standard-Errors or PCSE) produces more accurate standard errors compared to OLS by stating:

> ....in the case of homoscedasticity and contemporaneously independent errors, where OLS standard errors are accurate, PCSEs performed exactly, as well as the OLS standard errors. But (as expected) as the errors became less spherical, the performance of the OLS standard errors declined. Thus PCSEs dominate OLS standard errors; when PCSEs are not necessary, they perform as well as the OLS standard errors, and when OLS standard errors perform poorly, PCSEs still perform well. (p. 641)

They also show that PCSE has admirable small sample properties relative to other alternatives in the OLS estimation.

The main drawback from the PCSE approach is that the corresponding OLS estimates are inefficient. Further, OLS is subject to endogeneity bias if the explanatory variables are correlated with the error term.

Two-Stage Least Squares (2SLS)

As explained earlier, there is good reason to suspect that my model of economic growth and taxation suffers from endogeneity bias. One technique to address this problem is two-stage least squaress (2SLS). The suspected endogenous variable is the ***Change in Tax Rate***. As instruments, I will use the political representation variables, along with a variety of economic and demographic variables measured at the beginning of the respective five-year period. It is hypothesized that these instrumental variables are strongly correlated with the change in state tax rates but exogenous or uncorrelated with economic growth. The first hypothesis can be tested with an F-test for joint significance of the instruments in the first stage of 2SLS. The second hypothesis will be tested with Bollen testThe major disadvantage is that 2SLS assumes spherical errors, as in conventional OLS, which results in inefficient coefficient estimates.

Two-Stage Least Squares with Panel-Corrected Standard Errors (2SLS-PCSE)

Finally, I will estimate the model using 2SLS with panel-corrected standard errors from Beck and Katz (1995). The problem of endogeneity in the explanatory variables suspected to be endogenous in the model is appropriately handled by the 2SLS method. With proper exogenous instrumental variables, 2SLS will produce consistent coefficient estimates. Furthermore, the PCSE will handle serial correlation and cross-sectional correlation in the error terms. The result will be consistent estimates of standard errors. The main disadvantage of this approach is that the coefficient estimates, since they are unweighted, will be inefficient.

CHAPTER IV

DETERMINANTS OF STATE TAX RATES

IV.1. Introduction

This chapter investigates the factors that determine changes in state tax rates. There are two motivations for doing this. First, I want to identify variables that can serve as instruments for changes in state tax rates. Second, this will allow me to address endogeneity concerns about state tax policy by incorporating 2SLS estimation in my analysis of state economic growth.

Besley and Case (2000) suggest that greater use should be made of political variables as instruments in empirical studies of state's policies. The empirical work in this chapter follows up this suggestion. Thus, the second motivation is to identify new political variables that may prove valuable as instruments in other studies. This chapter proceeds as follows. Subchapter IV.2 summarizes previous studies that have examined the determinants of state fiscal policy. Particular emphasis will be given to the role of political variables. Subchapter IV.3 identifies the (i) demographic and (ii) political variables that are significantly related to state policy variables. Subchapter IV.4 and IV.5 estimate the determinants of changes in state tax rates. Subchapter IV.6 concludes.

IV.2. Summary of Previous Studies of the Determinants of State Fiscal Policy

Poterba (1994). Poterba (1994) examines the factors that determine how states respond to fiscal crises in the short-run. Fiscal crises have greater force at the state level because deficit finance is prohibited in most US states. Once a state has a fiscal crisis, politicians are confronted with a dilemma; to raise taxes or reduce outlays to restore fiscal balance.

The core analysis in Poterba (1994) consists of two regression models. One model has the change in real state expenditures per capita as the dependent variable; the other uses the change in real per capita state taxes. Both models use the following independent variables: unexpected deficit shock; a dummy variable that measures whether governor and the majority party of the lower house of legislature are from the same party; a dummy variable that measures whether a gubernatorial election is imminent; and various state fiscal institutions.

Poterba's findings suggest that states react to unexpected deficit shocks with real changes in fiscal position. Raising taxes within the fiscal year has a small contribution to deficit reduction, but raising taxes that take effect in the next fiscal year is a better option than cutting spending to correct unexpected deficits. With respect to political variables, Poterba (1994) estimates that states with a single-party government raise more taxes and cut more spendings in response to unexpected deficit shocks. He provides two interpretations for this finding: (i) reaching political consensus in single-party states is easier than that in divided-party state governments; and (ii) the governor and the state legislature are more politically vulnerable in the states with a divided-party government. Unpopular actions such as raising taxes or cutting spending will be a threat for control of legislative seats in the next election. Poterba also explores the effect of the governor's position in the electoral cycle to the magnitude of tax increases and spending cuts. The indicator for this variable equals unity in fiscal years immediately prior to gubernatorial elections. With a 10 percent level of confidence, his paper suggests that spending cuts and tax increases are significantly smaller when the governors are up for reelection.

Various state fiscal institutions include the following variables: the weakness in state anti-deficit rules, the existence of state tax limitation rules, and the level of the general fund balance. The reason for utilizing these variables is the fact that there are significant institutional differences across states. The estimates show that the states with weak anti-deficit rules adjust spending less in response to positive deficit shocks than those with strict rules. The states with tax limitation rules increase fewer taxes when they face deficit shocks than those with no tax limits. In contrast, there is not enough evidence that spending cuts are adjusted differently in states with tax and expenditure limits compared to those without such limits. The findings of this paper show that states with low expected general fund balances cut spending by a larger amount in response to positive deficit shocks.

The major drawback of Poterba is that the results are based on a narrow time period. Poterba employs a cross-sectional/time series data set from 1988 through 1992 for states with annual budget cycles. In total, the sample in this paper consists of only 131 observations from 27 continental states over a period of five fiscal years. This study notes that data for budget cuts from the National Association of State Budget Officers (NASBO) are only available beginning with the mid-1980s and additionally, the information on tax increases has only been collected since 1988.

Alt and Lowry (1994). Alt and Lowry (1994) examine whether state fiscal and political institutions affect the level of state spending and taxing rules. Using a formal model of fiscal policy where the state's revenue equals the state's expenditure, the paper concludes that (i) Democrats set state spending at a higher percentage of state personal income than Republicans; and (ii) states with divided governments have smaller responses to budget deficits than states with unified governments. Two dependent variables are employed in the empirical analysis: state real per capita revenues and state real per capita spending. Their paper includes 14 independent variables. These variables are broken into two categories: (i) demographic and economic variables and (ii) political variables. The demographic and economic variables consist of lagged real per capita revenues (in the revenue equation), current real per capita revenues (in the spending equation), real per capita state income (in the revenue equation), real per capita federal contributions (in the revenue equation), unemployment rate (in the spending equation), and lagged real per capita surplus. The political variables consist of a series of dummy variables, which include a dummy variable for Republican governors in non-southern states, a dummy variable for unified Republican government, a dummy variable for unified Democrat government, a dummy variable for split branch, a dummy variable for split legislature, a dummy variable for southern region, a dummy variable indicating whether the state has constitutional prohibition in carrying over a budget deficit into the subsequent fiscal year, and state level dummies.

The data for revenue, spending, federal contributions, personal income, and the unemployment rate cover the 48 states, (excluding Hawaii and Alaska) from fiscal years 1968 through 1987. All of these variables (except the unemployment rate) are based on real value, 1982-1984 per capita dollar figures and are obtained from the Census Bureau's *State Government Finances* (selected years), several issues of *Statistical Abstracts* and *The Book of the States*. For dummy variables, Nebraska is omitted for all years because it has a non-partisan or unicameral legislature. Minnesota is also excluded from 1968 to 1972 for the same reason as Nebraska while Maine is omitted from 1975 to

1978 because it had an independent governor. The total dataset is 931 state-years where 631 of them are non-southern states.

A shortcoming of the Alt and Lowry (1994) study is that the data set is decomposed into a number of sub-samples. For example, the 931 "state-year" observations are divided into eight separate samples of (i) (Nonsouthern) Unified Republican state government with deficit carryover restrictions; (ii) (Nonsouthern) Unified Republican state government with no deficit carryover restrictions; (iii) (Nonsouthern) Unified Democratic state government with deficit carryover restrictions; (iv) (Nonsouthern) Unified Democratic state government with no deficit carryover restrictions; (v) Split branch state government; (vi) Split legislature state government; (vii) Southern Unified Democratic government; and (viii) Southern Split branch state government.[11] The breakup of the total sample into these eight sub-samples precludes the use of state and time fixed effects. This method could produce better results of the effect of state fiscal and political institutions on taxes if these sub-samples have different structural relationships but there would not be a general conclusion whether political institutions affect the level of spending and taxing.

<u>Besley and Case (AER, 1995)</u>. Besley and Case, (AER, 1995) examine whether a state's tax-setting behavior is affected by the tax-setting behavior of neighboring states. This study makes assumptions that voters have fairly open information across the states and they are able to make comparisons between jurisdictions to overcome political agency problems. Another assumption is that there is "asymmetric information" between voters and politicians: voters know less about the cost of providing public good than

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[11] Alt and Lowery (1994) identify "Southern" states as Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North and South Carolina, Oklahoma, Tennessee, Texas, Virginia, and West Virginia.

politicians. There are two types of politicians: rent seekers who charge more than the cost of public goods and non-rent seekers who provide public goods and services at cost.

Voters choose to reelect the incumbents by evaluating the incumbents' performances and comparing them to neighboring states' incumbents' performances. If voters are skeptical about the need to increase a tax, even a small increase may force elected officials to lose their seats. However, if voters find that taxes are increasing everywhere, voters will not mind an increase in taxes, even with a large increase. These assumptions lead incumbents into yardstick competition in which they care about what incumbents in neighboring political jurisdictions are doing for the tax-setting policy.

Besley and Case (AER, 1995) use a two-year change in tax liability as the dependent variable in their model. Two types of tax liability are employed: personal income tax liability, and sales and corporate income tax liability. There are three groups of independent variables employed in this study. The first group is state economic indicator variables that measure incumbents' performance: (i) a two-year change in state income per capita; and (ii) a two-year change in state unemployment rate. The second group is the economic indicators that reflect neighboring incumbents' performance plus their tax-setting policy: (i) a two-year change in neighboring states' income per capita; (ii) a two-year change in neighboring states' unemployment rate; and (iii) a two-year change in neighboring states' tax liability. Besley and Case find that not all of the economic indicators significantly affect the probability of governor reelection. Since neighboring states' unemployment rate estimates have an insignificant coefficient and neighboring states' income appears to have a weak influence on reelection probabilities, the results show little evidence that voters measure their governor's performance in this way. However, the results suggest that voters are very sensitive to tax changes relative to the ones they observe in neighboring states, and this leads to votes against an incumbent whose tax changes are *relatively* high in regional standards.

The last group of independent variables is state demographic variables plus the governor's age; this group contains: (i) a two-year change in the state proportion of the young population (aged 5 to 17 years old); (ii) a two-year change in the state proportion of the elderly (aged 65 and above); and (iii) the governor's age. The estimated coefficients of the state demographic variables show that change in sales, income and corporate taxes increase with an increase in the proportion of elderly and young within the population. The proportion of young appears to be more significant than the proportion of elderly. This study also includes state and year dummy variables to absorb the impact of changes in national economic conditions and changes in federal fiscal behavior.

Using a cross-sectional/time-series approach, the dataset for the equation with personal income tax liability as the dependent variable only covers the period from 1979 through 1988 in 48 states (Alaska and Hawaii are excluded). This is because the data are only available within this period at the National Bureau of Economic Research (NBER). On the other hand, the equation that employs sales and corporate taxes as the dependent variable covers a longer period, from 1962-1988 since the data source from the Census Bureau's *Statistical Abstract* is more complete and comprehensive.

A shortcoming of the Besley and Case (AER, 1995) study is that there are relatively few explanatory variables to explain changes in state taxes, though the study does employ state and time fixed effects. If changes in state taxes affect economic performance, then there are endogeneity problems in the use of state income per capita and state unemployment rate as explanatory variables. Further, the explanatory variables (i) two-year change in the proportion young (aged 5-17) and (ii) two-year change in the proportion elderly (aged 65+) are by necessity plagued with measurement error problems since this data is only available at ten-year intervals from the U.S. Census.

Besley and Case (QJE, 1995). Another study by Besley and Case (QJE, 1995) examines whether governors in their last term behave differently with respect to taxing and spending behavior. The authors used a reputation-building model of political behavior to analyze the issue. Their argument is that governors facing a binding term limit behave differently compared to those who are able to run for reelection. This fact provides a source of variation in discount rates that can be used to test a political agency model.

Besley and Case start with the assumption of asymmetric information about the types of politicians. Voters judge and gauge the types of their incumbents' performances by using the outcome measures from incumbents. If incumbents want to be reelected, then the possibility of reelection will affect policy choices. Officials try to develop a reputation that enhances their reelection chances.

As indicators of policy choices in the model, seven variables are employed as dependent variables. They are as follows: (i) sales tax per capita; (ii) income tax per capita; (iii) corporate tax per capita; (iv) total taxes per capita; (v) state spending per capita; (vi) minimum wage; and (vii) maximum weekly benefit for temporary total disability. This study uses seven explanatory variables: state income per capita, the proportion of young (aged 5-17), the proportion of elderly (aged 65 and above), state population, a dummy variable of whether a Democrat incumbent is in his/her last term, a dummy variable of whether a Republican incumbent is in his/her last term, and finally, state and year effect dummies to absorb the changes in national economic conditions and federal fiscal and political changes.

The results of this study show that when a governor faces term limits, sales taxes per capita as well as income taxes will be higher in his/her final term than if he/she did not face the term limit. However, corporate taxes appear to be insignificantly affected. For the insignificant estimates on corporate taxes, this study finds only weak positive results on total taxes. The proportion of young (aged 5-17) is a positive and significant determinant of sales taxes, income taxes, corporate taxes, and total taxes. The proportion of elderly (aged 65 and above) is only a positive and significant determinant for sales taxes.

Results estimated by the model also suggest that term limits significantly affect state spending per capita, as do state demographic variables. State spending rises when the proportions of young increases while it falls with an increase in the proportion of elderly. Additionally, negative and significant effects of a binding term limit are observed on the real minimum wage policy while the effect of term limits on maximum weekly benefits appears to be positive but insignificant.

With respect to the effect of political party effects, Besley and Case (QJE, 1995) estimate that if the governor who faces the term limit is a Democrat, total per capita taxes and its components are higher by $10 to $15 on average. On the other hand, Republican governors in their last term reduce sales taxes, corporate taxes, and real minimum wage while raising income taxes and state spending per capita, though by a lesser amount than Democrats in their final terms of office.

The authors present this empirical study using cross sectional/time series data for 48 states (excluding Alaska and Hawaii) from 1950 to 1986. Data on the variables are taken from the Census Bureau's *Statistical Abstract of the United States*, *Compendium of State Governments*, and *The Book of States*. Other data sources are *Monthly Labor Review* and *the Report of the Minimum Wage Study Commission,* published by the Bureau of Labor Statistics.

A shortcoming of the Besley and Case (QJE, 1995) study is that it attributes all changes in state fiscal policy to the governor of that state. Information about the strengths of the political parties in the state legislature is omitted. Further, the main state demographic variables (proportion elderly and young) are used in the annual time series, cross-sectional analysis, despite the fact that this data is only available at ten-year intervals from the U.S. Census.

Poterba (1997). Poterba (1997) studies the impact of "demographic structure", particularly the proportion of a state's population that is elderly, on state education spending. This focus of the paper is motivated by the tension between family with children who mostly receive the return from tax-financed public education spending, and older households with owner-occupied homes who pay taxes that finance K-12 education. This generational difference is believed to lead to a tension in the political process in which educational budgets are set.

The dependent variables employed in this paper are per capita non-education direct spending and per child school-spending. Both of them are in logarithmic values.

The reason for including per capita non-education direct spending is to help estimate a "control specification" that may provide evidence of spurious relationships. Estimating the model with this variable as a dependent variable provide evidence on the effect of demographic and other variables on differences in public spending and/or allocative effects with respect to education and other programs.

There are two groups of explanatory variables in the empirical model of this paper: (i) state economic variables that include the logarithm of real per capita personal income and the logarithm of real federal aid to K-12 education; and (ii) state demographic variables, comprised by the logarithm of the proportion of school age children (aged 5-17) in the population, the logarithm of the proportion of elderly (aged 65 and over) in the population, the logarithm of the fraction of population who own homes, are non-white, live in urban areas, and live below the poverty line. To absorb the changes in national economic conditions and other changes in omitted variables, state and year dummies are also included.

The fraction of the young and the elderly in the population significantly affect per-child spending on education. With state and year dummies included, the proportion of elderly has a negative relationship. The results suggest that, other things being equal, states with more elderly voters spend less on public schools. Comparing this result to the one estimated by "control equation" in which the dependent variable is per capita non-education direct spending also strengthens this finding. The estimates of the "control equation" suggest that a larger fraction of the elderly in a state leads to a higher spending on non-education programs.

Poterba (1997) also finds that the percentage of school-age children significantly affects per capita education spending in a positive way. Further, the "control equation" supports this finding by implying that an increase in the young population reduces the state and local government spending per capita but raises the share of such spending that flows to education.

The estimated effects of real personal income per capita and the fraction of population that own homes, are non-white, live in an urban area, and live below the poverty line, and receive Federal aid are briefly described. The relationship between real personal income per capita and per-child spending on education is positive but not significant, as well as the relationship between the fraction of population that lives below poverty line and per-child education spending. The higher the fraction of homeowners in the state, the more the state will spend on per-child education. This may be viewed as the result of the fact that homeowners face a lower marginal tax price of public spending. However, the non-white fraction of the population gives a weak predictive power for per-child education spending. Additionally, the proportions of the population who live in an urban area negatively and significantly affect the level of per-child education spending.

Poterba (1997) measures all data variables in logarithm, and the data covers 48 continental states, every ten years, from 1960 to 1991, by applying the panel data approach. Monetary values from the dataset are reported in 1992-dollar value using national income and product accounts deflator for government purchase of goods and services. Data on state demographic variables are obtained from the US Census Bureau, and *the US Census of Population and Housing Report.* Several issues of the *Economic Report of the President* provide information about state economic variables. A shortcoming of the Poterba (1997) study is that it does not include any political party variables. Further, the study ignores endogeneity concerns caused by feedback effects from state spending decisions to state personal income.

Crain and Crain (1998). Crain and Crain (1998) investigate whether "current service budget baselines" increase state spending policy. A current service budget baseline sets the default level of public spending at the amount necessary to maintain existing services. This is in contrast to a "dollar budget baseline" in which the current level of expenditures is used as the baseline. Current service is widely criticized as biased toward higher spending in the existing budget process.

Crain and Crain use the growth in real spending per capita and the level of per capita spending as dependent variables in their two regression models. Their study employs 11 independent variables as follows: (i) a dummy variable to indicate whether the state uses a current service budget baseline procedure; (ii) personal income per capita; (iii) the population share under 18 years; (iv) a dummy variable to indicate whether the state has a constitutional balanced budget requirement; (v) "State Federalism Structure," a variable that measures the degree of centralized responsibility in government administration within the state; (vi) "Tax Revenue Structure," a variable that measures the share of state taxes revenues raised from individual income taxes; (vii) the proportion of the population who live in urban areas; (viii) a dummy variable to indicate whether the state has a 4-year term limit on governorship; (ix) "Party Stability" in the state Senate, . an index that measures the probability that the same party retains majority control of the state Senate; (x) "Party Stability" in state House of Representatives, an index to measure the probability that the same party retains majority control of the state House of

Representatives; and (xi) a set of regional dummies to control for the potential effects of region-specific factors that are either unobservable or omitted from the model.

The estimated coefficients show that during the 1980s, a current service baseline procedure had a positive and significant coefficient on spending growth. The current service baseline procedure led to higher spending than the dollar budget baseline procedure. The results also suggest that spending growth rates are significantly higher in states with 4-year terms limit on governance, as compared to states with only 2-year terms limits. The coefficient of "Party Stability" index for state Senates appears to be significant: more predictability in the continued majority control by the same party promotes higher spending growth. However, the "Party Stability" index for the state House of Representatives fails to have a significant effect on state per capita spending growth. By examining the estimated coefficients of the fiscal structure variables, I can see that states that concentrate greater fiscal responsibility at the state level had higher spending growth than those that concentrate greater fiscal responsibility at the local level. A heavier dependence on income tax than other state revenue sources results in higher state per capita spending growth. States that have no requirement on the Constitutional Budget Balance have significantly lower state per capita spending than those that have a requirement. Finally, state spending moves in a positive direction with personal income and the share of the young population but moves negatively with the share of the populations who live in urban areas.

Crain and Crain (1998) use a cross-sectional dataset of 47 states (excluding Alaska, Delaware, and Nebraska) and cover 10 years of observations, from 1980 through 1990. State per capita spending is in constant 1988 dollars. Most of the economic and demographic variables are obtained from the publication of the US Department of Commerce, the US Bureau of Economic Analysis, and the US Census Bureau. Meanwhile, the US Council of State Governments *Book of States*, biennial editions, and the US Census Bureau *State Government Finance*, annual editions are the main source of political variables. A shortcoming of Crain and Crain (1998) is the narrow time-frame of the study, 1980-1990. A further shortcoming is the fact that there is no role for party affiliation variables in the empirical analysis.

Vedder (1990). The last study reviewed in this chapter is a work by Vedder (1990). I saved this study for last because it comes closest to the analysis that I will undertake in this chapter. Although Vedder is primarily concerned with the effect of state taxes on economic growth,[12] he includes an analysis of the effect of political structure variables on the change in state tax rates. This is the only study that directly studies the determinants of changes in state tax rates.

Vedder uses a cross-sectional dataset of 48 continental states plus the District of Columbia with the dependent variable being the change in the aggregate state and local tax rate from 1967 to 1987, as measured by tax revenues per $1,000 of personal income. The explanatory variables included are: (i) the tax rate in the initial year 1967; (ii) the state's 1967 per capita income level; (iii) an indicator of the conservativeness of a state, as measured by the average percentage of people voting for the Republican candidate in the 1976 and 1988 presidential elections; (iv) the average aggregate tax rate in 1967 of all states bordering on the state in question; and (v) the change from 1967 to 1987 in the

[12] I have discussed and reviewed this study in chapter two with more detail descriptions. This study is considered to be the only one that uses the term of the change in state tax rates as dependent variable.

aggregate tax rate in the bordering states. It is clear that only economic and political variables were employed in the equation.

Vedder (1990) finds evidence that the states more likely to vote for Republican candidates also had significantly lower taxes. While Vedder (1990) does find a significant link between party affiliation and changes in state tax rates, his study is limited by a number of shortcomings. The inclusion of the District of Columbia is arguable. The regression analysis does not include any demographic characteristics of the states. Further, a great deal of information is thrown away in collapsing the data down to a cross-sectional sample. There is no doubt that state tax rates have had periods of substantial increase and decline over the 1967 to 1987 period.

IV.3. Implication of Previous Studies for Variable Selection

Previous studies suggest that both demographic and political variables may be important explanatory variables for changes in state tax rates. Tables IV.1 and IV.2 summarize the findings of previous studies with respect to the estimated effects of demographic and political variables. Columns (1)-(3) identify the study, the dependent variable, and the respective explanatory variables. Column (4) reports the estimated effects of the variables on taxes or expenditures. Column (5) reports the significance of the estimated coefficients.

****TABLE IV.1 HERE****

<u>State demographic variables.</u> What can we learn from previous studies with respect to the selection of demographic variables? As Table IV.1 reports, demographic variables are frequently found to have significant coefficients in state taxes and/or state expenditures regressions. The coefficients of the unemployment rate, the proportion of

the population aged 5-17 years old, the proportion of the population aged 65 and above, total population, the fraction of the population who own homes, and the fraction of the population who live in urban areas are all significant in some specifications. Unfortunately, there is little consistency. For example, while both Besley and Case studies find that the proportion of the population aged 5-17 years old is positively related to higher taxes, Poterba (1997) finds that this same variable is negatively related to school spending, and negatively (but insignificantly) related to non-school state spending.

****TABLE IV.2 HERE****

Political variables. A similar conclusion holds with respect to previous studies' findings on the effects of political variables. Table IV.2 reports that the following political variables are determinants of state taxes and/or spending with significant coefficients: control of the governorship and the lower house of the state legislature by the same party; an imminent gubernatorial election; the governor's age; a Democratic governor; a Democratic governor in his/her last term; a large share of state and local revenues; a gubernatorial term limit; a 4-year gubernatorial term limit; "party stability" in the state senate; and "party stability" in the state house.

As before, however, these findings generally lack consistency. For example, it seems contradictory that "party stability" in the state senate should be associated with higher spending, while "party stability" in the state house is associated with lower spending. The finding that comes closest to being a consistent finding in the literature is that party affiliation variables matter. Generally, a state which is characterized by a greater degree of "Democratic-ness" is likely to have higher taxes and spending than a state which is more Republican in nature. Nevertheless, even this finding is complicated by the fact that "Democratic-ness/Republican-ness" is measured in different ways by different studies.

In conclusion, while previous studies do not establish strong priors about the expected effects, they do establish the fact that demographic and political variables can be significant determinants of state tax policy. Amongst demographic variables, the (i) proportion of the population aged 5-17 years old, (ii) the proportion of the population aged 65 and above, and (iii) the fraction of the population who live in urban areas appear to be particularly important.[13] Amongst political variables, the findings of previous studies suggest that party affiliation variables should be included in analyses of state fiscal policy.

IV.4. Empirical Analysis of the Determinants of Changes in State Tax Rates

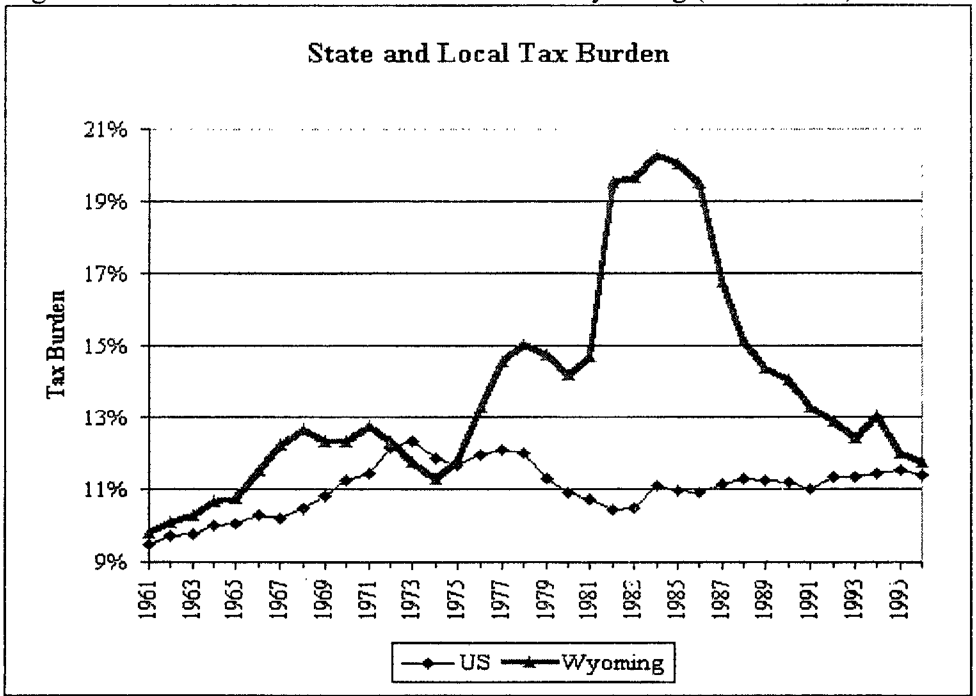
General Description of Study and Variables

As mentioned earlier, the objective of this chapter is to identify the empirical determinants of the change in state tax rate. Moreover, I try to identify instruments for the change in state tax rate that can be used in 2SLS estimation of state growth rates. My sample consist of a cross sectional/time series dataset on 45 states (Alaska, Hawaii, Nebraska, Minnesota, and Wyoming are excluded) from 1960 to 1999. Nebraska is excluded from the analysis because of missing information in political party variables (Nebraska has a non-partisan, or the unicameral system, in the state legislature). Minnesota is also excluded since it had a unicameral system in the state legislature from 1959 through 1970, and Wyoming is omitted because its state tax rate is heavily

[13] While the unemployment rate is also frequently a significant determinant of state taxes and/or expenditures, I choose not to include this variable in the empirical analysis below because of the concern with endogeneity.

dependent on severance taxes, which caused it to change dramatically in the late 1970s and early 1980s when the state experienced oil booms, as shown by Figure IV.1.

Figure IV.1 State and Local Tax Burden of Wyoming (1961-1995)



Source: *State and Local Tax Burden Information* compiled by Prof. W. Robert Reed and Prof. Cynthia L. Rogers, The University of Oklahoma. (http://faculty-staff.ou.edu/R/Cynthia.Rogers-1/TAX/WY_TB6096.htm)

Due to relatively little year-to-year variation in most of the variables, especially the change in state tax rate, I analyze the data using 5-year intervals. This is also to avoid the problem of data unavailability and further, to overcome the problem of "wipe out" and "fiscal cycle" effects mentioned in the study by Beasley and Case, QJE (1995). Consequently, this study has data for eight time periods for the total of 360 observations: (1) 1960-1964, (2) 1965-1969, (3) 1970-1974, (4) 1975-1979, (5) 1980-1984, (6) 1985-1989, (7) 1990-1994, and (8) 1995-1999.

All variables in the tax rate change equation, except the political variables, take their values at the beginning of the period. By doing this, the problem of endogeneity is minimized. The dependent variable employed is the change in state tax rate (***Change in Tax Rate***). The value of this variable is calculated as the difference between the state tax rate in year *t* and the rate in the previous 5 years (*t-4*). State tax rate is commonly referred to as "Tax Burden" and is defined as the percentage of the level of state and local taxes to the state personal income. Since tax calculations involve fiscal years and personal income is based on calendar years, tax rates are calculated by dividing state and local taxes in period *t* by state personal income in period *t-1*. The smallest change in state tax rate during my 5-year interval observations appeared in North Dakota from 1970 to 1074 in which state tax rates decrease by 3.814 percentage points. While Wisconsin had the highest change in state tax rates by increasing 2.120 percentage points from 1960 to 1964. The earliest data (1950's until 1980's) for state and local taxes is downloaded from the US Census Bureau homepage. I hand-entered the latest data (1990's) from the US Census Bureau *Government Finance* (selected years). In the next two sub chapters, I will describe two groups of the independent variables: economic and demographic variables and political variables based on the descriptive statistics in Table IV.3.

TABLE IV.3 HERE*

Economic and Demographic Variables

State tax rates at the beginning of the period (***Initial Tax Rate***) is included as a determinant of tax rates changes since I expect that competition among states encourages tax rate convergence. Beasley and Case (AER, 1995) argue that "yardstick competition" forces the incumbents to reduce the tax-burden close to their neighboring states' tax rate. Accordingly, I expect the sign of this variable to be negative. In my sample, Virginia was the state that had the lowest tax burden. In 1960, 7.15 percent of its real state personal income was burdened by state and local taxes. On the other hand, New York had the highest tax rate in 1970 with 15.85 percent.

Data on the percentage of the elderly aged 65 and above at the beginning of period (***Elderly***) are collected from the US Census Bureau *Statistical Abstract of the United States* (selected years) and its homepage. The percentage of the elderly (aged 65 and above) was not available for 1961 through 1964, but I overcame this data unavailability problem by using 5-year interval data instead of yearly observations, as mentioned earlier. During the time periods I observed, the average of the percentage of the elderly in the US was 10.7 percent; the lowest percentage of elderly was in Nevada in 1965 at 5.2 percent. The highest percentage of elderly was 18.2 percent in Arkansas in 1990.

Data on population density at the beginning of the period (***Density***) and its components, total population and land area, is loaded from the homepage of the US Census Bureau. In the annual observations, the state with the highest population density was New Jersey in 1999 with 1,046 persons per square mile. And the lowest population density was Nevada in 1964 with 4 persons per square mile.

The last demographic variable included is education attainment at the beginning of the period (***Education***), which is defined as the fraction of the population aged 25 years old and above who completed college or a higher degree program. Data on this variable was only available for the years 1960, 1970, 1980, 1990, 1995, and 1999 in the US Census Bureau *Statistical Abstract of the United States*. The SAS "expand" procedure[14] was utilized to impute values for the missing years. The state with the lowest fraction of person 25 years old and above who completed a college or higher degree program was Illinois in 1964, with only 4.22 percent. In contrast, 31.67 percent of Colorado's population 25 years old and above completed college or higher degrees in 1999.

Data of income earned in agricultural (***Farm***) and manufacturing (***Manufacturing***) sectors are calculated as the proportion of the state personal income at the beginning of period. Data on state agricultural and manufacturing income was loaded from the homepage of the US Bureau of Economic Analysis. On average, for all states in my time observations, farm income constituted only 3.84 percent of personal income. In 1960, South Dakota had the highest percentage of annual farm income to personal income with 24.23 percent. On the other hand, the lowest value was North Dakota with -6.55 percent in 1980. During the time periods I observed, in 1965 Michigan had the highest concentration of manufacturing with 36.55 percent of its state personal income coming from manufacturing.

The variables ***Elderly*** and ***Density*** are included because they were found to be significant in previous studies. The other demographic variables are included because they appear in the income growth equation as explanatory variables, and must be included in the tax rates change equation to perform the 2SLS analysis. However, one can

[14] The "expand" procedure converts time series from one sampling interval or frequency to another and interpolates missing values in time series. With this procedure, ones can collapse time series data from higher frequency intervals to lower frequency intervals, or expand data from lower frequency intervals to higher frequency intervals. For example, quarterly estimates can be interpolated from an annual series, or quarterly values can be aggregated to produce an annual series.

imagine that these variables may be measuring preferences for state spending and taxes policy amongst different special interests in the state.

Political Variables

The political variables employed as the determinants for the change in state tax rates are divided into two categories: political variables from the states' federal legislature and ones from state's state legislature. The political variables from federal legislature are generally approximated by only one variable, which is the adjusted mean of the American for Democrat Action (ADA) score.[15] ***ADA Average*** in this study measures the mean ADA score for the state's federal politicians (mean ADA score in House of Representatives plus mean ADA score in the US Senate divided by 2), over the 5-year period. I employ the mean value over the five-year period lagged one year (*t-5* to *t-1* rather than *t-4* to *t*) because legislative changes voted in one fiscal year typically do not go into effect until the next fiscal year. This variable is designed to measure the states' federal legislators' preferences for spending and taxes.

At the federal level, a higher ADA score is generally associated with support for higher federal spending and taxes.[16] I believe that voters who support federal legislators with higher ADA scores will also support state legislators who support higher spending and taxes. Thus, the prediction is that this variable will be positive. The adjusted ADA score data is loaded from the homepage of Tim Groseclose, a Political Science Professor of Stanford University.[17]

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[15] This variable is commonly used as a measure of how liberal or conservative a member of congress is in their office. Democrats are known more liberal than Republicans.

[16] It is possible to have a negative number for ADA score since I use Real (Inflation-adjusted) ADA score produced by Groseclose, Levitt, and Snyder Jr. (1999)

[17] http://faculty-gsb.stanford.edu/groseclose/turboadas.webpage.update061302.xls

According to this measure, the most liberal state was Massachusetts in 1979 with a mean ADA score of 85.44. In that year, Democrats controlled both the House of Representatives and the Senate in the Massachusetts' federal legislature. On the other hand, Idaho was the most conservative state in 1984, with an average of only 1.89 real ADA scores. which was extremely conservative compared with other states in the same year. Again, I can also note that for Idaho, Republicans controlled both of the chambers in the federal legislature.

The second category is the political variables in the state's state legislature. ***Democrat Legislature*** refers to the percentage of years during the 5-year period, in which that Democrat controlled both chambers in the state legislature, and ***Republican Legislature*** refers to the percentage of years during the 5-year period, in which Republican controlled both chambers in the state legislature. Based upon the differences in spending and taxes preferences of Republicans and the Democrats at the federal level, my prediction is that ***Democrat Legislature*** will positively related, and ***Republican Legislature*** will be negatively related to changes in state tax rate. Only 20 out of 45 states experienced a full 5-year unified Republican, while 33 states experienced a full 5-year unified Democrat during the time periods I observed. In fact, 12 states experienced a full 40-years unified Democrat from 1959 through 1999. Of those states, 92 percent are southern states. There was only one state, New Hampshire, that was unified Republican for all observation years. The main data source of these political variables in the state legislature and their components is the US Census Bureau *Statistical Abstract of the United States* (selected years).[18]

[18] The reason of not including governor as political variable in my study is statistical. I do not find that governor showing significant coefficient in my preliminary tax model regressions in any specification

Many state and time-specific factors have important effects on the tax rates change (such as unemployment rate, level of average wages, and the rise of legislature-imposed special state spending and revenues). Those factors may affect the level of state income taxes and transfer payments; I need to recognize the potential influences of such effects by allowing for state and time-fixed effects in the equation. In this case, I try to identify the coefficients of interest from variation among states (over time) in other structures that cannot be explained by economy-wide shocks to demographics and political conditions. The inclusion of the state and time-fixed effects in the equation also help me to avoid the problem of "specification bias" in the model.

IV.5. Empirical Results

In this section, I report the results of regressing the change in state tax rate on state economic and demographic conditions and political variables. The first subsection reports the basic political specification results with the inclusion of cross-state fixed effects and time effects in the model, while the second, third, and fourth models add demographic and economic variables and also interaction variables among them. By interacting one specific variable to others, I will be able to alter their real impacts on state tax rates. Last two equations include the interaction variables between time fixed effects and demographic variables to analyze the robustness of the model.

Equation 1

I begin the analysis with a model of the change in state tax rate with political variables and ***Initial Tax Rate*** that controls for state and time fixed effects. The use of state and time fixed effect is intended to overcome the problem of bias from inadvertently omitting any variables that potentially affects both income growth equation and the change in state tax rates equation. Let the ***Change in Tax Rate*** **be** denoted by DTR_{st}, the basic specification is:

$$DTR_{st} = \beta_0 + \beta_1\, Initial\ Tax\ Rate_{st} + \beta_2\, Republican\_Legislature_{st}$$

$$+ \beta_3\, Democrat\_Legislature_{st} + \beta_4 ADA\_Average_{st} + \sum_{i=5}^{48} \beta_i \mu_s$$

$$+ \sum_{i=49}^{55} \beta_i \lambda_t + \varepsilon_{s,t} \qquad \text{.................. (equation.1)}$$

The equation has a good fit, explaining approximately 46.5 percent of the variation in the change in state tax rates. The state fixed and time fixed effects are jointly significant at a 0.01 level of significance in this equation.

The estimations shown in the first column of Table IV.4 indicate that the coefficient on ***Initial Tax Rate*** is significant and has a negative sign, as expected. That initial levels of the state tax rate are negatively correlated with their changes reflects the process of convergence in state tax rates. The point estimate suggests that, *ceteris paribus*, a state having a tax rate that is one percentage points higher than other states at the beginning of a 5-year period will increase its tax rate 0.47 percentage points less than other states over that period.

There are three political structure variables in this equation: adjusted mean ADA score (***ADA Average***), the percentage of years that Democrats controlled both of the chambers in the state legislature (***Democrat Legislature***), and the percentage of years that Republicans controlled the state legislature (***Republican Legislature***). As expected, the coefficient estimate of ***ADA Average*** is positive; a higher ADA score in the federal legislature tends to increase state tax rates. ***Democrat Legislature*** and ***Republican Legislature*** also have the expected signs. States in which Republicans (Democrats) have controlled both houses of the legislature are less (more) likely to raise taxes during that period. However, neither of the associated coefficients is significant at the 5% level, and only ***Democratic Legislature*** is significant at the 10% level. However, a test of the null hypothesis that the political structure variables corporately have no effect on the change in state tax rates is rejected at the 5% significance level.

<u>Equation 2</u>

In consideration of public choice matters, I add 3 interactive variables: ***ADA Average*** $\times$ ***Farm***, ***Republican Legislature*** $\times$ ***Farm***, and ***Democratic Legislature*** $\times$ ***Farm*** to equation 1. The main reason for adding these interaction terms is statistical. The equation that includes ***Farm*** interaction terms has the lowest Akaike Information Criterion (AIC) and Schwartz Information Criterion (SIC).[19] Another reason is that it is well known that agricultural interests from farmer groups have a disproportionate impact on political outcomes in both federal and state legislatures. Regardless of the very-small shares of farm income to total state earning, farmer groups are still important voters that help politicians to get elected or incumbents to get reelected. Historically, the Democratic Party drew its followers from farmer groups. In 2000, Democratic budget resolutions favored farmer groups by providing increases in income assistance for farmers. In contrast, additional money for agriculture was not a sure thing in the Republican budget resolution. However, these farmers' political alignments have changed because the Republican platform released at the 2000 Republican Convention is more in line with agriculture. For example, the platform put fourth specific goals to repeal the inheritance tax, and to grant a one-time exemption on the capital gains tax from the sale of farming

[19] AIC and SIC are commonly used in the issue of model selection in Econometrics.

products. Accordingly, the proportion of personal income earned from the agricultural sector (***Farm***) is interacted with the three political variables I have from equation 1.

The regression results of equation 2 reported in the third column of Table IV.4 show a higher adjusted R^2, 0.395 compared to 0.369 in equation 2. This helps to indicate the joint significance of ***Farm*** interaction terms. The formal testing also shows that ***Farm*** interaction terms' coefficients are jointly significant with a p-value of 0.0008. With the inclusion of ***Farm*** interaction variables into the equation, now I have a total of six political variables in the equation. The inclusion of ***Farm*** interaction terms causes the coefficient of ***ADA Average*** to become significant. A test that both of the ADA (***ADA Average*** and ***ADA Average*** $\times$ ***Farm***) coefficients are equal to zero is rejected with a p-value of 0.0064. The coefficient of ***Democrat Legislature*** and ***Republican Legislature*** remain insignificant but in spite of this insignificancy, I will still include them since a test of the null hypothesis that all of the political variables' coefficients (i.e., ***ADA Average***, ***ADA Average*** $\times$ ***Farm***, ***Republican Legislature***, ***Republican Legislature*** $\times$ ***Farm***, ***Democrat Legislature***, and ***Democratic Legislature*** $\times$ ***Farm***) are jointly insignificant is rejected at 99 percent confidence level.

Due to the inclusion of interaction terms in the equation, I need to calculate the estimates of marginal impacts of the original political structures variables By employing a simple differential rule, I use the following formulas to gather the marginal impacts of the original political variables:

$$\frac{\partial DTR}{\partial ADA\_Average} = \beta_{ADA\_Average} + \beta_{ADA\_Average*FARM}\, x\left(\overline{FARM}\right)$$

$$\frac{\partial DTR}{\partial Republican\_Legislature} = \beta_{Republican\_Legislature} + \beta_{Republican\_Legislature*FARM}\, x\left(\overline{FARM}\right)$$

$$\frac{\partial DTR}{\partial Democrat\_Legislature} = \beta_{Democrat\_Legislature} + \beta_{Democrat\_Legislature*FARM}\, x\left(\overline{FARM4}\right)$$

When evaluated at the mean value of ***Farm***, the estimated marginal impacts for ***ADA Average***, ***Democrat Legislature***, and ***Republican Legislature*** are 0.0049, 0.0022, and -0.0023 respectively. These signs are consistent with what was expected and estimated in equation 1. However, none of these marginal impacts is significant at a 5% significance level when evaluated at the mean value of **Farm.**

Equation 3

Equation 3 adds the economic and demographic variables into equation 1.

$$DTR_{st} = \beta_0 + \beta_1 ADA\_Average_{st} + \beta_2 Democrat\_Legislature_{st} + \beta_3 Democrat\_Legislature_{st} + \beta_4 Initial\ Tax\ Rate_{st} + \beta_5 Elderly_{st} + \beta_6 Density_{st} + \beta_7 Farm_{st} + \beta_8 Manufacturing_{st} + \beta_9 Education_{st} \sum_{i=10}^{53} \beta_i \mu_s + \sum_{i=54}^{60} \beta_i \lambda_t + \varepsilon_{s,t} \quad \text{.................. (equation 3)}$$

The equation explains approximately 51 percent of the variation in the change in state tax rates. The estimations shown in the third column of Table 1, again suggest that the coefficient on the ***Initial Tax Rate*** is significant and has a negative sign as expected. The positive and significant estimate of the state's population density at the beginning of period (***Density***) shows that states with higher population density are to be more likely to increase taxes than less densely populated states. The estimation results also suggest that all else equal, jurisdictions with more elderly populations are less likely to increase taxes than states with younger populations. Further, states whose economies that are more concentrated in the agricultural and manufacturing sectors, and whose populations are more educated, are individually estimated to be less likely to increase taxes than other states. The estimates of variable ***Farm***, ***Manufacturing*** and ***Education*** are all shown to be significant at a 5% level of significance. The significances of state characteristic variables is also supported by the hypothesis testing which rejects the null hypothesis that all of the State characteristic variables corporately have no effect on the change in state tax rates. The associated p-value is 0.000002.

Again, the coefficient estimate of the political variables: ***ADA Average***, ***Democrat Legislature***, and ***Republican Legislature*** have the expected signs but insignificant coefficients. And, again, I reject the null hypothesis that all of the political structure variables jointly have no effect on the change in state tax rates (p-value is 0.0294).

<u>Equation 4</u>

Equation 4 adds the farm interaction effects to the specification of equation 3. This equation has a higher adjusted R^2, 0.437 compared to those in previous equations. This is consistent with the joint significance of the ***Farm*** interaction effects in the model. Formal testing also shows that the ***Farm*** interaction terms' coefficients are jointly significant with a p-value of 0.0006. With the state characteristic variables in the equation, I find that the inclusion of the ***Farm*** interaction terms together with state characteristic variables causes each of the coefficients of political structure variables, except ***Republican Legislature*** to become significant. A test that both of the ADA, both of the Republican Party, and both of the Democratic Party coefficients are equal to zero, respectively is rejected with a p-value ranging from 0.0013 to 0.011. Moreover, a test with a null hypothesis that all six political variables corporately have no effect on the change in state tax rates is rejected at the 95 percent level of confidence.

Using the marginal impact formulas presented above, I find that the signs of marginal impacts of the political variables confirm my expectations. ***ADA Average*** and ***Democrat Legislature*** have positive signs while ***Republican Legislature*** has a negative one. However, unlike the result from equation 2, the marginal impacts of the political variables when evaluated at the mean value of ***Farm*** are significant at the 5% of significance level ***Democrat Legislature*** and 10% for ***ADA Average***.

Equation 5

Next, I try to check the robustness of the political variables estimates by exploring the effects of time specific differences among states. I include interaction variables between time fixed effect and state characteristic variables (***Density***, ***Farm***, and ***Manufacturing***) into equation 3. The reason for the inclusion of time interaction variables is that states may differ from each other through time periods. For example, there were policies and regulations passed by Federal government on education, farm and manufacturing sectors throughout the observation periods. Those polices may induce different effects for state demographic variables over different time periods.

With 21 additional variables, the results of equation 5 show a higher adjusted R^2, 0.567 compared to previous equations. A test of the null hypothesis that all time and state characteristic interaction terms have no effect on the change in state tax rates is rejected with a *p*-value of 0.0001. If I compare the results of equation 5 to the results of equation 3, I see that all variables consistently have the same estimated signs. I decide to select this equation as the better equation compared to previous equations because it has the lowest AIC and SIC, as shown in Table IV.4

Equation 6

Having knowledge that equation 5 is the most appropriate model to select concerning the AIC and SIC scores, I finally include the ***Farm*** and political variables interaction terms I have in equations 2 and 4 to analyze the robustness of the political variables' effects on state tax rates. The result of this equation shows that about 70% of the variation in state tax rates can be explained by this model. A test of the null hypothesis that ***Farm*** and the political variables interaction terms have no effect on the state tax rates is rejected with a *p*-value of 0.06.

The results demonstrate the consistent sign estimates for all major variables. The point estimate of ***Initial Tax Rate*** suggests that, *ceteris paribus*, a state having a tax rate that is one percentage point higher than other states at the beginning of a 5-year period will increase its tax rate 0.49 percentage points less than other states over that period. All political variables but ***Republican Legislature*** have significant estimated signs as expected. When evaluated at the mean value of ***Farm***, the estimated marginal impacts for ***ADA Average***, ***Republican Legislature***, and ***Democrat Legislature*** are 0.00578, -0.00285, and 0.00092, respectively. These signs are consistent with what was expected and estimated in equations 2 and 4. Even so, only the marginal impact of ***Democrat Legislature*** is significant at the 5% significance level when evaluated at the mean value of ***Farm***. The marginal impacts of ***ADA Average*** and ***Republican*** are significant only at the10% significance level.

F. Implications and Discussion

Comparing and analyzing the estimates of the six equations allow me to test whether there is any difference between the impacts of Republican legislatures and those of Democrats legislatures on the variability of the change in state tax rates. Table IV.5 reports the results of testing the difference in the marginal impacts of Democrats and Republicans. In each of the 3 equations containing political variables and their interaction terms, the null hypothesis that Democrats and Republicans have equal impacts on the change in state tax rates is rejected with associated p-values consistently ranging from 0.013 to 0.016. The results suggest that the impact of Republican legislatures is different than the impact of Democrats in determining changes in state tax rates.

The test results in Table IV.5 also allow me to make some practical interpretations on the impact of changes in the partisan makeup of state As a practical matter, I ask what difference political party control of the state legislature means for the change in state tax rates. Using the value of the difference between the marginal impact of Democrats and the marginal impact of Republicans in equation 1 in Table IV.5, I calculate that if Democrats controlled both houses of legislature for a given 5-year period, then state tax rate would be 0.4 percentage points higher on average than if Republicans controlled both branches of the legislature for that period. This follows the conventional wisdom that Democratic legislatures favor higher tax rates compared to Republicans. Since the costs of passing regulations and policies are less in the single majority party, states in which the Democrats controlled both branches of the legislature had higher state tax rates. The 0.4 percentage points different are also consistent in each of the 3 equations. This fact gives me more confidence that I have estimated the true effect of the political variables on the change in state tax rates.

For the sample period 1960-1999, the mean 5-year change in state tax rates is equal to 0.229 percentage points. Meanwhile, the overall mean ***Initial Tax Rate*** for this period was approximately 10.5 percentage points. Thus political party control of the legislature has a substantial impact on the determination of state tax rates.

IV.6. Conclusion

The empirical evidence presented in this chapter suggests that demographic, economic, and political structure variables are important for the determination of the change in state tax rates. Percentage of elderly at the beginning of the period (***Elderly***), population density at the beginning of the period (***Density***), income share from agricultural sector at the beginning of the period (***Farm***), income share from manufacturing sector at the beginning of the period (***Manufacturing***), and educational attainment at the beginning of the period (***Education***) appear to be significant determinants in at least 2 out of 6 equations at the 10 percent significance level. In general, states whose economies are more concentrated in the agricultural or manufacturing, and whose more elderly and whose populations are more educated are estimated to be less likely to increase taxes than other states, while states having higher population densities are estimated to be more likely to increase taxes than less densely populated states.

In the matter of political structure variables, there are two major findings from the results. First, political variables are important for the determination of the change in state tax rates. ***ADA Average***, ***Republican Legislature***, and ***Democrat Legislature*** show significant and appropriate signs of coefficient estimates as expected with at least a 10 percent significance level. States whose federal legislators are characterized by higher ADA scores are more likely to increase taxes. Moreover, states in which Republicans control both houses of the state legislature are less likely to raise taxes during that period while Democrats are more likely to raise taxes when they control both houses of the state legislature. This finding provides prima facie evidence that these variables can serve as instruments in two-stage least squares estimations of the state growth equations. Second, the sign estimates and significances of political variables are shown to be robust to the inclusion of the set of the conditioning variables into the model.

Table IV.1: The Estimated Effect of Demographic Variables on State Taxes and Expenditures: Results from Previous Studies

Study	Dependent Variable	Variable	Estimated Effect	Significant at 5% level?
Besley and Case, (AER, 1995)[b]	Taxes	1) Unemployment rate	Mixed	Sometimes
		2) The proportion of population aged 5 – 17 years old	Mixed	Sometimes
		3) The proportion of population aged 65 and above	Positive	Sometimes
Besley and Case, (QJE, 1995)[c]	Taxes	1) The proportion of population aged 5 – 17 years old	Positive	Yes
		2) The proportion of population aged 65 and above	Positive	Sometimes
		3) Population	Mixed	Sometimes
Besley and Case, (QJE, 1995)[d]	Expenditures	1) The proportion of population aged 5 – 17 years old	Positive	Yes
		2) The proportion of population aged 65 and above	Negative	Yes
		3) Population	Negative	Yes

Study	Dependent Variable	Variable	Estimated Effect	Significant at 5% level?
Poterba (1997)[e]	Expenditures	1) The proportion of the population aged 5 – 17 years old	Negative	Sometimes
		2) The proportion of the population aged 65 and above	Mixed	Sometimes
		3) The fraction of population who own homes	Positive	Yes
		4) The fraction of population who live in urban areas	Negative	Sometimes
		5) The fraction of non-white population	Positive	No
		6) The fraction of population below poverty line	Negative	No
Crain and Crain (1998)[f]	Expenditures	1) The proportion of the population aged 5 – 17 years old	Positive	No
		2) The fraction of population who live in urban areas	Negative	Yes

NOTES:
[a] *Estimates taken from Table 1, page 819 of Alt and Lowery (1994).*
[b] *Estimates taken from Table 4, page 37 of Besley and Case (AER, 1995).*
[c] *Estimates taken from Table IV, page 780, columns (1)-(4) of Besley and Case (QJE, 1995).*
[d] *Estimates taken from Table IV, page 780, column (5) of Besley and Case (QJE, 1995).*
[e] *Estimates taken from Tables 3 and 4, pages 57 and 58, columns (2)-(4) of Poterba (1997).*
[f] *Estimates taken from Table 3, page 431, column (3) of Crain and Crain (1998).*

Table IV.2: The Estimated Effect of Political Variables on State Taxes and Expenditures: Results from Previous Studies

Study	Dependent Variable	Variable	Estimated Effect	Significant at 5% level?
Poterba (1994)[a]	Expenditures	1) Governor and the majority party of the lower house of the legislature are from the same party 2) Gubernatorial election is imminent	Positive Mixed	Sometimes Sometimes
Poterba (1994)[b]	Taxes	1) Governor and the majority party of the lower house of the legislature are from the same party 2) Gubernatorial election is imminent	Mixed Negative	Sometimes Yes
Alt and Lowry (1994)[c]	See note below.	See note below.	See note below.	See note below.
Besley and Case, (AER, 1995)[d]	Taxes	1) Governor's age	Mixed	Sometimes
Besley and Case, (QJE, 1995)[e]	Taxes	1) Republican governor is in his/her last term 2) Democratic governor is in his/her last term 3) Democratic governor	Mixed Positive Mixed	No Yes Sometimes
Besley and Case, (QJE, 1995)[f]	Expenditures	1) Republican governor is in his/her last term 2) Democratic governor is in his/her last term 3) Democratic governor	Positive Positive Positive	No Yes Yes

Study	Dependent Variable	Variable	Estimated Effect	Significant at 5% level?
Crain and Crain (1998)[g]	Expenditures	1) Constitutional balanced budget requirement	Negative	No
		2) State share of state + local revenues	Positive	Yes
		3) Dependence on state income taxes	Positive	No
		4) Gubernatorial term limit	Positive	Yes
		5) 4-year Gubernatorial term limit	Positive	Yes
		6) "Party Stability" in state senate	Positive	Yes
		7) "Party Stability" in state house	Negative	Yes
Vedder (1990)	Taxes	1) Measure of support for Republican presidential candidates	Negative	Significant

NOTES:
[a] *Estimates taken from Table 5 on page 817, columns (1), (3), and (5) of Poterba (1994).*
[b] *Estimates taken from Table 5 on page 817, columns (2), (4), and (6) of Poterba (1994).*
[c] *Signs and significances are difficult to determine in Alt and Lowery (1994) because this study estimates separate regressions for each of eight different subgroups.*
[d] *Estimates taken from Table 4, page 37 of Besley and Case (AER, 1995).*
[e] *Estimates taken from Table V, page 782, columns (1)-(4) of Besley and Case (QJE, 1995).*
[f] *Estimates taken from Table V, page 782, column (5) of Besley and Case (QJE, 1995).*
[g] *Estimates taken from Table 3, page 431, column (3) of Crain and Crain (1998).*
[h] *Estimates taken from Table 3, page 99 of Vedder (1990).*

Table IV.3: Descriptive Statistics

Variable	Mean	Std Dev.	Minimum	Maximum
Change in Tax Rate	0.2289	0.7102026	-3.8138378	2.1202783
Initial Tax Rate	10.5342	1.3424867	7.1526656	15.8320497
ADA Average	41.4217	18.1051594	1.8928442	85.4437721
Democrat Legislature	56.7778	45.7028742	0	100
Republican Legislature	26.0555	39.4106616	0	100
Elderly	10.6830	2.1125393	5.2	18.2
Density	158.7411	210.6379607	2.6320312	1022
Farm	2.7458	3.8446750	-6.5505760	24.2280664
Manufacturing	16.9434	7.3811766	2.9743608	36.5557554
Education	14.3782	5.8955821	4.220000	31.6742736

Table IV.4: Regression Results

(Dependent Variable = Change in State Tax Rates)

	ESTIMATES					
VARIABLE	**Equation (1)**	**Equation (2)**	**Equation (3)**	**Equation (4)**	**Equation (5)**	**Equation (6)**
ADA Average	0.005275 (1.5628)	0.00906* (2.1645)	0.003666 (1.08655)	0.01227* (2.2803)	0.00528 (1.568)	0.00866* (2.0225)
ADA Average × Farm	-	-0.001516* (-2.1585)	-	-0.00237* (-2.0677)	-	-0.00105 (-1.7385)
Democratic Legislature	0.002489 (1.7835)	0.00236 (1.6062)	0.002154 (1.6027)	0.00399* (2.7385)	0.002036 (1.5924)	0.00384* (2.805)
Democratic Legislature × Farm	-	0.0000604* (0.19433)	-	-0.001124* (-1.9823)	-	-0.001064* (-2.3939)
Republican Legislature	-0.002078 (-1.16542)	-0.001918 (-1.05111)	-0.001695 (-0.95878)	0.000789 (0.39858)	-0.00202 (-1.3681)	-0.000141 (-0.00826)
Republican Legislature × Farm	-	-0.000133 (-0.480967)	-	-0.00128* (-1.81701)	-	-0.000987* (-2.16275)
Initial Tax Rate	-0.47407* (-8.742)	-0.445208* (-8.32297)	-0.504668* (-9.47811)	-0.52185* (-9.34215)	-0.48452* (-8.9701)	-0.48711* (-9.005)

Elderly	-	-	-0.113862* (-2.33698)	-0.08514 (-1.63166)	-0.06092 (-1.29164)	-0.05871 (1.2064)
Education	-	-	-0.05140* (-2.25329)	-0.04548* (-2.01827)	-0.02387 (-1.06842)	-0.021626 (-0.96685)
Density	-	-	0.005194* (3.73138)	0.004867* (3.36948)	0.00186 (0.77045)	0.001241 (0.49789)
Farm	-	-	-0.06485* (-3.57383)	0.10391 (1.39731)	-0.02553 (-1.3198)	0.081658 (1.59527)
Manufacturing	-	-	-0.05677* (3.31644)	-0.052075* (-2.92375)	-0.02087 (-1.01561)	-0.02837 (-1.3741)
Other Control Variables	1) State Fixed Effects 2) Time Fixed Effects		1) State Fixed Effects 2) Time Fixed Effects		1) State Fixed Effects 2) Time Fixed Effects 3) Time*Farm Interactions 4) Time*Manufacturing Interactions 5) Time*Density Interactions	
Observations	360	360	360	360	360	360
R^2 (Adjusted R^2)	0.4657 (0.3690)	0.492567 (0.39478)	0.51089 (0.41274)	0.5364 (0.43773)	0.665437 (0.56796)	0.67561 (0.57652)
AIC (SIC)	1.8349 (2.4394)	1.8000 (2.4369)	1.7744 (2.43288)	1.7375 (2.42837)	1.51131 (2.3965)	1.49711 (2.4146)

Test of Significance: Political Variables	$p = 0.00369$	$p = 0.000749$	$p = 0.0295$	$p = 0.021198$	$p = 0.00649$	$p = 0.0081$
Test of Significance: State Fixed Effects	$p = 0.000000$	$p = 0.00000$	$p = 0.0000$	$p = 0.0000$	$p = 0.0000$	$p = 0.0000$
Test of Significance: Time Effects	$p = 0.000703$	$p = 0.000021$	$p = 0.00173$	$p = 0.00257$	$p = 0.22565$	$p = 0.29128$
Test of Significance: Time Interaction Effects	-	-	-	-	$p = 0.0001$	$p = 0.0001$

NOTE: *t*-statistics are reported below coefficient estimates and are calculated using heteroscedastic robust standard errors. Asterisks indicate significance at the 5 percent level.

Table IV.5: Estimated Effects of Political Variables

VARIABLE	Estimates Derived from Table IV.3.					
	Equation (1)	Equation (2)	Equation (3)	Equation (4)	Equation (5)	Equation (6)
Marginal Impact of ADA Average	-	0.004895 (1.69)	-	0.005747 (1.64)	-	0.00578 (1.46)
Marginal Impact of Democratic Legislature	-	0.0022 (1.24)	-	0.0009 (2.02)	-	0.0009 (2.21)
Marginal Impact of Republican Legislature	-	-0.00228 (0.93)	-	-0.00272 (1.38)	-	-0.00285 (1.79)
Marginal Impact of Democratic Legislature minus Marginal Impact of Republican Legislature	-	0.00448	-	0.00362	-	0.00377
p-value associated with test of H_0: Marginal Impact of Democratic Legislature – Marginal Impact of Republican Legislature = 0	-	$p = 0.016$	-	$p = 0.016$	-	$p = 0.016$

Note: *t*-statistics are reported below coefficient estimates and are calculated using heteroscedastic robust standard errors. Asterisks indicate significance at the 10 percent level of significance.

[a] marginal impacts are calculated at the mean of *Farm*

CHAPTER V

EFFECTS OF STATE TAXES ON ECONOMIC GROWTH

In this chapter I focus on the effect of state taxes on economic growth. I want to estimate whether increases in state taxes result in higher or lower state economic growth. Previous chapters discussed the following "Model of Economic Growth and Taxation":

$$\Delta Y_{s,t} \equiv Y_{s,t} - Y_{s,t-j} = \beta_0 + \beta_1 Y_{s,t-j} + \beta_2 \Delta TR_{s,t} + \beta_3 TR_{s,t-j} + \sum_{i=4}^{k} \beta_i X^i_{s,t-j} + \mu_s + \lambda_t + \varepsilon_{s,t}, \quad \text{(V.1)}$$

where $s = 1,2,\ldots, 45$; $t = 1964, 1969, 1974,\ldots, 1999$; and $j = 4$. In this chapter I estimate this model. For my sample I use cross-sectional and time series data observations of 45 states with eight, 5-year periods of observations covering the period 1960 to 1999. The model and the data are described in detail in Chapter III.

The dependent variable is the change in the log of state real personal income ($\Delta Y_{s,t}$), which is my measure of state economic growth. The major explanatory variables are the two tax variables, ***Change in Tax Rate*** during the five-year period ($\Delta TR_{s,t}$) and the value of state tax rates at the beginning of the five-year period ($TR_{s,t-j}$), ***Initial Tax Rate***. The tax rates are calculated using tax burden. I include these two tax variables in order to capture both the short- and long-run effects of taxes on the economic growth.

Since my specification does not hold state and local government spending constant, these tax variables should be interpreted as representing the net effect of taxes on economic growth. That is, taxes introduce distortions in economic decision-making that produce an inefficient allocation of resources. These inefficiencies are expected to cause lower growth of real per capita personal income. On the other hand, taxes are used to fund state and local expenditures. Ceteris paribus, these expenditures should stimulate the production of goods and services and result in higher growth of real per capita personal income. As these two effects conflict, it is an empirical question as to which effect is stronger.

I include a number of control variables to minimize the danger of omitted variable bias. Exogenous growth theory predicts that states with lower initial income levels will grow faster than states with higher initial incomes, ceteris paribus, resulting in convergence of state incomes. In order to hold constant this effect, I include the lagged value of the log of state real personal income at the beginning of the five year period, represented by the variable $Y_{s,t-j}$ in Equation (5.1). I call this variable ***Initial Income***.

Other explanatory variables ($X^{i}_{s,t-j}$) are as follows: (i) population density at the beginning of the period (***Density***); (ii) the percent of the population aged 25 years old and above at the beginning of the period who have completed college or a higher degree program (***Education***); (iii) the percent of the population that is aged 65 and above at the beginning of the period (***Elderly***); (iv) the percent of state personal income earned in the agricultural sector at the beginning of the period (***Farm***); and (v) the percent of state personal income earned in the manufacturing sector at the beginning of the period (***Manufacturing***).

Endogenous growth theory predicts that education will generate productive externalities that will result in higher rates of economic growth. Thus, I predict that the coefficient for ***Education*** will be positive: states with higher levels of educational attainment should experience faster rates of economic growth. Other than ***Education***, I do not have strong prior beliefs about the signs of the coefficients for the other control variables.

On the one hand, ***Density*** may be associated with higher economic growth because greater population concentration may allow economies of scale and scope that contribute to growth. On the other hand, ***Density*** may have a number of problems associated with it that would serve to diminish economic growth. In particular, congestion and crime are two economic phenomena that are positively related to ***Density*** and that may serve to inhibit economic growth.

The greater the fraction of elderly in a state, the smaller the fraction of the population that is engaged in labor market work. For this reason, one would expect ***Elderly*** to be negatively correlated with economic growth. On the other hand, many states actively recruit retirees as a form of economic development. The idea is that retired workers generally import wealth with them. This wealth can serve as a stimulus to economic growth. By this argument, one would expect ***Elderly*** to be positively associated with economic growth.

Technological innovations have contributed to a secular downsizing of the agricultural sector over the last century. Economic growth is increased when resources are released from lower-valued sectors to higher-valued sectors. Thus, it may be that the states with the highest concentration of agricultural activity benefit the most from this economic transition. In this case, ***Farm*** would be expected to be positively related to economic growth. On the other hand, it might also be the case that states with relatively large concentrations of agricultural activity suffer the most from further downsizing in this sector, causing ***Farm*** to be negatively related to economic growth. Similar arguments apply with lesser force to ***Manufacturing***, as this sector has also seen significant employment downsizing during the sample period.

Note that all the explanatory variables except ***Change in Tax Rate*** are entered with their initial values or values at the beginning of the respective five-year periods. In other words, if my sample is the five-year period 1960-1964, I will use values from 1960 for "beginning of the period". Statistically, the use of the initial levels is designed to avoid endogeneity in the model.

State fixed effects (μ_s) and time fixed effects (λ_t) are included in the model to capture the influence of omitted variables associated with state-specific characteristics and national shocks that affect per capita personal income (PCPI) due to secular growth, business cycles, population trends, federal and fiscal policies, etc. These omitted variables may explain state growth rates and may be correlated with the tax variables.[20]

Table V.1.A presents a rank ordering of the dependent variable, ***Growth,*** and the two demographic variables ***Density*** and ***Education*** over all the states in my sample. Table V.1.B does the same for the demographic variables ***Elderly***, ***Farm***, and ***Manufacturing***. These tables report that the states with the highest average, five-year growth rates in the sample are Nevada (26.50 percent), Arizona (22.79 percent), and Florida (21.46 percent). The states with the lowest average, five-year growth rates are West Virginia (8.38 percent), Pennsylvania (9.65 percent), and New York (9.65 percent).

New Jersey has the greatest population density (932.10 persons per square mile); Montana has the lowest population density (5.20 persons per square mile). Colorado has the highest level of educational attainment (20.35 percent of the population has a college degree or better), Arkansas has the lowest level of educational attainment (9.26 percent). Florida's reputation as a retirement haven is well earned. It has the highest proportion of

[20] See chapter II for a more detail explanation of the inclusion of state and time fixed effects.

citizens who are aged 65 or older (15.05 percent). Utah and Nevada are virtually tied as the "youngest" states (7.35 and 7.36 percent, respectively). The states with the highest shares of earnings coming from agriculture and manufacturing are South Dakota (12.63 percent) and Michigan (30.02 percent), respectively. The states with the lowest shares of earnings in agriculture and manufacturing are Rhode Island (0.24 percent) and Nevada (3.61 percent).

Having reviewed the motivations, methods and results from the literature in preceding chapters, I shall now discuss my estimates of how state taxes affect economic growth using different estimation methods. The discussion begins with ordinary least squares (OLS) and ends up with the Two-Stage Least Squares with panel-corrected standard errors (2SLS-PCSE).

V.1. Ordinary Least Squares (OLS)

The specification for the OLS model employs a total of 59 explanatory variables: the 2 tax variables (***Change in Tax Rate*** and ***Initial Tax Rate***); 6 control variables (***Initial Income***, ***Density***, ***Education***, ***Elderly***, ***Farm***, and ***Manufacturing***); 44 state dummies and 7 time dummies. In this specification I assume that the error terms follow the usual classical assumptions of (i) homoscedasticity, (ii) no serial correlation (the correlation of a variable with itself over successive time intervals), and (iii) no cross-sectional correlation (the correlation between state economies). I also assume exogeneity in the explanatory variables. In particular, I assume that there is no reverse causality between the dependent and independent variables.

The first column of Table V.2.A presents the results for the OLS estimation method with state and fixed effects. ***Change in Tax Rate*** has a negative and statistically significant coefficient. The interpretation of the coefficient is that an increase of one percentage point in the tax burden over a five-year period lowers economic growth by 3.48 percent relative to other states within that same time period. The other tax variable, ***Initial Tax Rate***, also has a negative and significant coefficient. It indicates that a state having a tax rate one percentage point higher at the beginning of a five-year period will, on average, grow by 1.5 percent less than other states over that subsequent period.

These two tax variables estimate different effects from a tax change. The variable ***Change in Tax Rate*** tells me the immediate impact on state income growth. However, after this five-year period, this tax change gets embodied in the tax rate level, resulting in a higher initial tax rate for the next (and subsequent) five-year periods. The subsequent impact of tax rate on state income growth is shown by the coefficient of ***Initial Tax Rate***. The OLS estimates from Column (1) indicate that tax increases have negative effects on economic growth in the both the short- and long-run. The hypothesis testing I conduct shows that the tax variables' coefficients are jointly significant at the 0.0001 level of significance.

Turning attention to the control variables, only the coefficients of ***Initial Income*** and ***Education*** are significant at the 5-percent level. Both have the expected signs. ***Initial Income*** is negatively related to economic growth. A one percent increase in a state's income at the beginning of a five-year period is associated with a 0.1 percent lower growth rate during that period. This is consistent with convergence in state incomes as predicted by exogenous growth theory.

Education is positively related to economic growth. An increase of 1 percent in the share of the population having a college education or better is associated with an increase of 0.53 percent in that state's five-year growth rate. The hypothesis tests at the bottom of the table indicate that both sets of fixed effects' coefficients (state and time) are individually significant below the 0.0001 significance level.

The remainder of the demographic variables has insignificant coefficients at the 5-percent level of significance. The point estimates indicate that, *ceteris paribus*, states with more elderly in their population or a greater concentration of manufacturing activity will grow faster than states that have fewer elderly or a smaller concentration of manufacturing activity, respectively. While insignificant, the size of the coefficient for ***Elderly*** is predicted to have a larger impact than ***Education***. On the other hand, states that have greater dependence on farming or a higher population density will grow slower than states with less dependence on farming or a lower population density, respectively.

V.2. OLS with Heteroscedastic Consistent Standard Errors (OLS-HCSE)

I next relax the assumption of homoscedasticity by calculating heteroscedastic-consistent standard errors (HCSE). As the exact form of heteroscedasticity is unknown, I cannot employ weighted least squares. Instead, I continue to employ the (inefficient) OLS coefficient estimates. The conventional formula to calculate standard errors with OLS is biased when heteroscedasticity is present, so I follow White's procedure[21] to calculate consistent standard errors.

With heteroscedasticity, the error covariance matrix can be represented in general form by

[21] White, Halbert, " A Heteroscedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroscedasticity", Econometrica, 48, 1980, 817-838

$$\text{var}(\varepsilon) = \text{E}(\varepsilon\varepsilon') = \begin{bmatrix} \sigma_1^2 & 0 & . & . & 0 \\ 0 & \sigma_2^2 & & & 0 \\ . & & . & & \\ . & & & . & \\ 0 & 0 & . & . & \sigma_n^2 \end{bmatrix} = V \tag{V.2}$$

Consequently, the conventional OLS coefficient standard errors are incorrect and the conventional test statistics based on these standard errors are invalid. The correct covariance matrix for the OLS coefficient vector is now:

$$\text{var}(\boldsymbol{b}) = (\boldsymbol{X'X})^{-1}\boldsymbol{X'VX}(\boldsymbol{X'X})^{-1} \tag{V.3}$$

White's procedure rewrites $\boldsymbol{X'VX}$ in an alternative form and replaces the unknown V with the estimate of $\hat{V} = \text{diag}\{e_1^2, e_2^2, \ldots\ldots, e_n^2\}$, where e_n denotes the OLS residual from the nth observation. The square roots of the elements on the principal diagonal of

$$\text{var}(\boldsymbol{b}) = (\boldsymbol{X'X})^{-1}\boldsymbol{X'\hat{V}X}(\boldsymbol{X'X})^{-1} \tag{V.4}$$

are the estimated, heteroscedastic-consistent standard errors. It is worth noting that this procedure only corrects for heteroscedasticity. It does not address serial correlation or cross-sectional correlation problems.

Column (2) of Table V.2.A reports the results of estimating the effect of taxes on economic growth using OLS with heteroscedastic-consistent standard errors. Of course, the coefficient estimates are identical to those in Column (1), since OLS is still used to calculate them. The difference lies in the calculation of the standard errors. Theoretically, while OLS produces biased estimates of the standard errors, the bias can be either positive or negative.

Comparing results from the first and second columns of Table V.2.A, one can see that the differences are both negative and positive. The standard errors of the coefficients for the two tax variables are larger when estimated using OLS-HCSE as opposed to OLS, resulting in smaller t-ratios. On the other hand, the standard errors for several of the control variables. such as ***Density*** and ***Elderly*** are larger.

Overall, however, the main results are unchanged: The coefficients of control variables ***Initial Income*** and ***Education*** are individually significant. The two sets of state and time fixed effects are significant. The remaining coefficients of demographic variables, ***Density***, ***Elderly***, ***Farm***, and ***Manufacturing*** are insignificant. Most importantly, the two tax variables' coefficients, ***Change in Tax Rate*** and ***Initial Tax Rate***, continue to be individually and jointly significant.

V.3. OLS with Panel-Corrected Standard Errors (OLS-PCSE)

As shown earlier, for general error covariance matrix, V, the correct formula for the sampling variability of the OLS estimates is given by the square roots of the diagonal terms of matrix:

$$\mathrm{var}(\boldsymbol{b}) = (X'X)^{-1}X'VX(X'X)^{-1}.$$

The previous section allowed V to consist of a general form of heteroscedasticity. In this section, I want to allow for the possibility that V may also consist of serial correlation and cross-sectional correlation.

Beck and Katz (1995) propose a technique for estimating V when the error structure is characterized by (i) groupwise heteroscedasticity, (ii) serial ($AR(1)$) correlation, and (iii) cross-sectional correlation. Further, they advise that researchers assume that the data is characterized by a common $AR(1)$ parameter, as opposed to allowing for separate, groupwise serial effects. They call this approach "Panel-Corrected Standard Errors" (PCSE). In this section, I extend my analysis by implementing their procedure. To implement Beck and Katz's (1995) procedure, I have written my own computer code using SAS/IML.

Column (3) of Table V.2.A re-estimates the specification of the first two columns using OLS, this time calculating standard errors using Beck and Katz's (1995) PCSE procedure. Similar to OLS-HCSE, the OLS-PCSE method does not change the point estimates of the coefficients. Only the standard errors and corresponding *t*-ratios change.

Once again, while some of the standard errors change, the main results stay the same. In particular, the two tax variables, ***Change in Tax Rate*** and ***Initial Tax Rate***, remain individually and jointly significant.

V.4. Adding Interaction Effects

The preceding analysis used OLS to estimate the effects of taxes on economic growth holding constant a variety of control variables. Several estimation procedures were employed to obtain alternative estimates of the coefficients' standard errors. In all cases, the tax effects were individually and jointly significant and estimated to be negatively associated with state economic growth. In this section I want to check for the robustness of these results by adding additional variables to the specification.

I tried adding both quadratic forms of variables, and including interaction effects. After a process of hypothesis testing, I determined that the best extension of the original specification added interaction effects between the time dummy variables and three of the control variables: ***Density***, ***Farm***, and ***Manufacturing***[22]. The practical effect of including time interaction variables is that it allows the coefficients for these variables to change

[22] I also add interaction variables between ***Change in Tax Rate*** and ***Initial Income*** to let the coefficients for each of these variables change relative to each other. The reason is because I suspect the causal effect of growth rate and tax in the first place (*note:* income is the component of growth). However, the regression result shows that this interaction variable does not change the main result of the effect of taxes on economic growth analysis.

over time. This corresponding specification now employs a total of 80 explanatory variables; the 59 from the previous specification along with 21 time interaction effects.

Table V.2.B repeats the estimation of Column (1) through (3), only this time the equation specification includes the time interaction effects described above. A comparison of the respective R^2 values indicates a substantial increase from adding the time interaction effects: the R^2 increases from 0.6533 to 0.7743. Further, a hypothesis test of whether the time interaction effects are jointly equal to zero is soundly rejected using all three estimates of the covariance matrix: The associated *p*-values never rise above 0.0001.

The main results are unaffected by the inclusion of these additional variables: The signs of the coefficients in the original specification are the same. The two tax variables' coefficients, ***Change in Tax Rate*** and ***Initial Tax Rate***, remain individually and jointly significant. And the control variables ***Initial Income*** and ***Education*** individually have significant effect.

That being said, it should be noted that the estimated tax effects are substantially different. The OLS estimates of the coefficients for ***Change in Tax Rate*** and ***Initial Tax Rate*** in the specification without the time interaction effects are -3.4842 and -1.4965, respectively. The corresponding estimates in the specification with the time interaction effects are -1.9787 and -1.5922. In other words, the model with the interaction effects estimates a smaller immediate effect of a tax change, but a slightly larger long-term effect from raising taxes.

To summarize, the alternative OLS-based estimates all indicate that taxes have a significant, negative effect on economic growth, both in the short- and long-run. There are two additional problems I want to address. Ideally, I would like to weight the observations to obtain consistent estimates given the non-spherical error structure as described earlier in Chapter III. This would entail using feasible general least squares (FGLS). However, while the FGLS technique is able to accommodate groupwise heteroscedasticity and serial correlation, it cannot accommodate cross-sectional correlation. The problem is that there are too few time periods relative to cross-sectional units (states); i.e. $T < N$. Hence, I cannot use FGLS to obtain consistent estimates. While I would have liked to implement this procedure, Beck and Katz (1995) provide some consolation: Their Monte Carlo work suggests that even if FGLS could be implemented, one would, in fact, be better off using OLS with Panel Corrected Standard Errors (OLS-PCSE).

The second problem of my study consists of endogeneity. I am concerned that the variable ***Change in Tax Rate*** may not only affect state economic growth but also be affected by state economic growth. The results from Chapter IV identified a number of variables that can serve as instruments. Accordingly, I expand my study by employing two-stage least squares (2SLS) to obtain estimates of the effects of taxes on economic growth. This should correct for possible endogeneity.

V.5. Two-Stage Least Squares (2SLS) and Two-Stage Least Squares with Panel Corrected Standard Errors (2SLS-PCSE)

As discussed earlier in Chapter III, the suspected endogenous variable in my model is the ***Change in Tax Rate*** variable. To illustrate the 2SLS procedure, consider the simple regression model, $y = \alpha + \beta x + \varepsilon$. The OLS estimator for this model is:

$$b = (X'X)^{-1} X'y \qquad \text{(V.5)}$$

where X is the matrix including the explanatory variable and the constant term, and y is the dependent variable.

OLS assumes zero covariance between ε and x, $E(\varepsilon_i x_i) = 0$; that is, the disturbance ε and explanatory variable x should be uncorrelated. If, instead, x and ε are correlated, then it is not possible to assess their individual effects on the dependent variable y. Applying ordinary least squares (OLS) to the model under these circumstances results in inconsistent estimates. That is, even as the sample size approaches infinity the estimates of the parameters will not converge to the true population values. To remedy this problem, one can apply 2SLS. To implement the 2SLS, I need to identify one or more instruments for x.

Suppose that it were possible to find instruments collected in data matrix Z that satisfied two conditions:

1. The variables in Z must be uncorrelated with the disturbance vector ε, $E(Z_i\varepsilon_i) = 0$.
2. The variables in Z must be correlated with x. Recall that this condition is satisfied in my model specification because I found that there exist political variables that were significant determinants of ***Change in Tax Rate***.

The 2SLS procedure can be thought of as consisting of two stages. In the first stage, each of the variables in the X matrix is regressed on Z to obtain a matrix of fitted values $\hat{X}$:

$$\hat{X} = Z(Z'Z)^{-1}Z'X = P_Z X \tag{V.6}$$

The first stage of 2SLS in my model specification has already been discussed in Chapter IV. I showed there that political variables are jointly significant determinants of ***Change in Tax Rate***, and this result was robust using a wide variety of variable specifications.

Consequently, I believe that political representation variables are good instruments to employ in the 2SLS estimation procedure.

The second stage consists of regressing y on $\hat{X}$ to obtain the estimated β vector:

$$\hat{\beta}_{2SLS} = (\hat{X}'\hat{X})^{-1}(\hat{X}'y) = (X'P_Z X)^{-1}(X'P_Z y) \qquad \text{(V.7)}$$

This method should produce consistent parameter estimates. The only condition for identification is that the number of instruments is greater than, or equal to, the number of independent variables.

To determine if my original specification has endogeneity, I conduct a Hausman test of endogeneity. Let the original model be given by $y_1 = Z_1\delta_1 + \alpha_1 y_2 + \varepsilon_1$, where y_2 is the suspected endogenous explanatory variable. Hausman (1978) suggests comparing the OLS and 2SLS estimators of α_1 as a formal test of endogeneity: if the suspected endogenous variable is really exogenous, then OLS and 2SLS will both produce consistent estimates of α_1, and the two estimates should be "close." An asymptotically equivalent version of this test is described below.

1. Regress y_2 on the instrumental variable matrix $Z = [Z_1 \quad Z_2]$. Let e_2 be the corresponding residual vector from this regression.
2. Estimate the model, $y_1 = Z_1\delta_1 + \alpha_1 y_2 + \rho_1 e_2 + \varepsilon_1$. This is nothing more than the original model supplemented by the vector of residuals from the preceding equation. Note that y_1 is the dependent variable in the original model.
3. Test whether the coefficient ρ_1 is statistically different from zero. The null hypothesis states that the suspect explanatory variable is exogenous. Rejection of the null hypothesis is interpreted as evidence that the suspect explanatory variable is endogenous.

In 2SLS estimation, asymptotic efficiency increases with the number of instruments. However, the small sample bias of the estimator may deteriorate as the number of instruments increases. Further, as more instruments are employed, degrees of freedom are lost and this weakens the power of statistical tests.

In this study, I employ two sets of instrumental variables, one for each of the specifications employed in Tables V.2.A and V.2.B. The first set of excluded instruments consists of the three political variables, ***ADA Average***, ***Democratic Legislature***, and ***Republican Legislature***. The resulting ***Z*** matrix consists of 61 instrumental variables; the 58 exogenous variables included in the first specification, plus the three political variables.

The second set of excluded instruments consists of six political variables: ***ADA Average***, ***Democratic Legislature***, and ***Republican Legislature***; along with three interaction terms, ***ADA Average*** × ***Farm***, ***Democratic Legislature*** × ***Farm***, and ***Republican Legislature*** × ***Farm***. I include the ***Farm*** interaction terms because I found that they added substantial explanatory power to the model. I tried other interaction terms, but their coefficients were not significant. The corresponding ***Z*** matrix for the second specification consists of 85 instrumental variables; the 79 exogenous variables included in the OLS second specification, plus the six political variables.

Good instruments satisfy the following two criteria. First, they are significantly correlated with the included endogenous variable. Second, they are uncorrelated with the error term. The following two tests are designed to indicate whether my instruments satisfy these conditions.

In 2SLS, the first stage consists of estimating the included endogenous variable on the full set of instruments. As Bound, Jaeger, and Baker (1995) demonstrate, it is important that the "excluded instrumental variables" be jointly significant in the first stage equation. They recommend performing a partial *F* test with the null hypothesis being that the excluded instrumental variables all have zero coefficients.

For the two specifications described above, this consists of testing whether the sets of coefficients corresponding to the variables (i) ***ADA Average***, ***Democratic Legislature***, and ***Republican Legislature***, and (ii) ***ADA Average***, ***Democratic Legislature***, ***Republican Legislature***, ***ADA Average*** × ***Farm***, ***Democratic Legislature*** × ***Farm***, and ***Republican Legislature*** × ***Farm*** are jointly equal to zero. Rejection of this hypothesis is evidence that my instruments satisfy the first criterion of a good instrument. In Tables V.2.A and V.2.B, I identify this test as the "1st Stage Test of Excluded Instruments."

When the original equation is exactly identified, it is impossible to test whether the instruments are uncorrelated with the error term, outside of their role as predictors of the included endogenous variable. However, both of my specifications are over-identified; that is, the number of instruments is greater than the number of explanatory variables. To check whether the instruments that over-identify the model are valid instruments, I conduct a hypothesis test recommended by Bollen (1996).

The corresponding null hypothesis is that the residuals are independent of the instrumental variables. The test is carried out as follows:

1. Calculate ***e***, the vector of residuals from regressing the dependent variable on the explanatory variables in the original (endogenous) specification.

2. Regress e on all the instrumental variables in an auxiliary equation and save the corresponding R^2 value.

3. Form the test statistic: $\chi^2 = n \cdot R^2$, where n is the sample size.

4. The test statistic has a chi-squared distribution with degrees of freedom equal to the number of instruments less the number of right hand side variables in the original equation.

5. The null hypothesis is that the instruments are uncorrelated with the dependent variable, a necessary condition for variables to be good instruments.

Failure to reject the null hypothesis is evidence that my instruments satisfy the second criterion of a good instrument. In Tables V.2.A and V.2.B, I identify this test as the "2nd Stage Test of Excluded Instruments."

Column (4) of Table V.2.A reports the results of re-estimating the first specification using conventional 2SLS. The last three rows of the table report the (i) Hausman test, (ii) the 1st Stage Test of Excluded Instruments, and (iii) the 2nd Stage Test of Excluded Instruments. The Hausman test shows little evidence of endogeneity. In fact, the corresponding *p*-value is close to 1. Correspondingly, the coefficient estimates for the 2SLS estimates are very close to the OLS estimates. Even so, the tax variables' coefficients continue to be jointly significant at well below the 5 percent level.

Column (5) of Table V.2.A generalizes the error structure to allow for (i) heteroscedasticity, (ii) serial correlation, and (iii) cross-sectional correlation. As discussed above, panel-corrected standard errors (PCSE) are calculated to produce correct standard errors for this more general error structure. Again, there is little substantial change in the results: the tax variables' coefficients are still jointly significant.

Columns (4) and (5) of TABLE V.2.B repeat the preceding analysis, this time using the more expanded specification including the interaction effects. The Hausman test, reported at the bottom of the table, just barely fails to reject the null hypothesis of exogeneity at the 5 percent level. The t-value is 1.91, and the associated p-value is 0.0569. The next row reports the 1st Stage Test of Excluded Instruments. The null hypothesis that the political variables with interaction effects are unrelated to ***Change in Tax Rate*** is strongly rejected. This is evidence that these variables satisfy the first criterion of a good instrument.

The last row reports the 2nd Stage Test of Excluded Instruments. This test estimates whether the excluded instruments are unrelated to the dependent variable aside from their influence on the included endogenous variable. Unfortunately, the null hypothesis is rejected, suggesting that at least one of the excluded instruments belongs in the original equation.

The 2SLS coefficient estimates reported at the top of the table show that correcting for endogeneity within this expanded specification has a substantial effect. Both the short- and long-term effects of a tax change--corresponding to the coefficient estimates for ***Change in Tax Rate*** and ***Initial Tax Rate***, respectively--are much larger than the corresponding OLS estimates. The tax variables' coefficients are each negative and individually significant in both the 2SLS and 2SLS-PCSE regressions. And, as in all previous estimations, they are also jointly significant.

V.6. Endogeneity and the Validity of the Instrumental Variables

The previous analysis finds that my set of instruments fails to satisfy both criteria for good instruments. In this section, I revise my set of instruments to satisfy these criteria. I find that the two instruments, ***Democrat Legislature*** and the interaction variable between ***FARM*** and ***Democrat Legislature***, are the reason why my instruments failed the Bollen test. Accordingly, I exclude these instruments and re-estimate the 2SLS specification with the remaining instruments.

Table V.3 repeats the 2SLS estimations from Table V.2.A and B, only this time I estimate 2SLS by excluding ***Democrat Legislature*** and ***Democrat Legislature*** × ***Farm*** in the list of instrumental variables (Columns [2] and [4]). The coefficient estimates change substantially. In the model without time interaction variables, the ***Initial Tax Rate*** coefficient is now positive. In the model with time interaction variables included, both ***Change in Tax Rate*** and ***Initial Tax Rate*** are still negative. However, the sizes of the coefficients in both regressions have decreased substantially, and none are significant. Further, I cannot reject the null hypothesis that both tax variables are equal to zero in either of the two specifications.

On the bright side, the included set of instruments now satisfies both of the necessary criteria. The bottom of Table V.3 reports the results of the 1st and 2nd Stage Tests of the excluded instruments. When the interaction terms are not included (cf. Column [2]), I find that the political variables are (i) significantly related to ***Change in Tax Rate*** (the corresponding *p*-value is 0.0028); and (ii) insignificantly related to the residual term in the auxiliary equation (*p*-value is 0.2685). The results are similar when the interaction terms are included (cf. Column [4]). The corresponding *p*-values for the two tests are 0.0166 and 0.2245, respectively.

I now turn to the results for the Hausman tests of exogeneity, also reported at the bottom of Table V.3. In both case, I fail to reject the null hypothesis that ***Change in Tax***

Rate is exogenous. The p-values for the tests in Columns (2) and (4) are 0.0868 and 0.9100, respectively. Therefore, I conclude that the problem of endogeneity of ***Changes in Tax Rate*** in my model does not exist, at least not as severe as I expected before. The conventional OLS and its variants, especially OLS with panel-corrected standard errors (OLS-PCSE) estimation methods are good enough to produce the estimates for explaining the effect of taxes on economic growth.

V.7. Summary

Having compared and analyzed the results of different estimation methods, I am confident that taxes, both initially and subsequently, have a negative impact on state economic growth. Increases in ***Change in Tax Rate*** and a higher level of ***Initial Tax Rate*** at the beginning of the five-year period will lead to lower economic growth. All the different OLS estimation methods I conduct in this study suggest the same conclusion of the negative effect of tax variables on state growth. While I obtain different results in some of my 2SLS results, in the end I cannot reject the null hypothesis of exogeneity.

TABLE V.1.A: Rank Ordering of State Values for *Growth*, *Density*, and *Education*

RANK	*Growth*	*Density*	*Education*
1	26.50 (Nevada)	932.10 (New Jersey)	20.35 (Colorado)
2	22.79 (Arizona)	779.34 (Rhode Island)	19.30 (Connecticut)
3	21.46 (Florida)	691.63 (Massachusetts)	18.85 (Maryland)
4	19.17 (Georgia)	607.64 (Connecticut)	18.48 (Massachusetts)
5	18.48 (Colorado)	397.59 (Maryland)	17.70 (Utah)
6	18.46 (New Hampshire)	362.44 (New York)	17.63 (California)
7	17.52 (Virginia)	287.16 (Delaware)	17.44 (Virginia)
8	17.39 (North Carolina)	259.99 (Pennsylvania)	17.33 (New Jersey)
9	17.19 (Texas)	256.85 (Ohio)	17.15 (Washington)
10	16.91 (South Carolina)	198.28 (Illinois)	17.13 (Vermont)
11	16.86 (Utah)	159.25 (Florida)	16.68 (New York)
12	16.44 (Washington)	152.70 (Michigan)	16.50 (Delaware)
13	16.31 (Tennessee)	147.84 (California)	16.33 (Arizona)
14	16.21 (Arkansas)	146.63 (Indiana)	16.30 (New Hampshire)
15	15.55 (Mississippi)	135.70 (Idaho)	16.02 (Oregon)
16	15.13 (Maryland)	128.82 (Virginia)	15.84 (New Mexico)
17	14.97 (California)	109.33 (North Carolina)	15.47 (Kansas)
18	14.86 (Oregon)	103.86 (Tennessee)	14.98 (Montana)
19	14.51 (Idaho)	96.51 (South Carolina)	14.75 (Texas)
20	14.35 (Vermont)	94.77 (New Hampshire)	14.68 (Wisconsin)
21	13.94 (Kentucky)	91.44 (Georgia)	14.55 (Rhode Island)
22	13.69 (New Mexico)	85.95 (Kentucky)	13.98 (Illinois)
23	13.62 (Alabama)	82.38 (Louisiana)	13.69 (Florida)
24	13.19 (Delaware)	81.67 (Wisconsin)	13.55 (Idaho)
25	13.05 (Connecticut)	75.82 (West Virginia)	13.54 (Oklahoma)
26	12.72 (Massachusetts)	72.60 (Alabama)	13.33 (Georgia)

RANK	*Growth*	*Density*	*Education*
27	12.48 (New Jersey)	69.31 (Missouri)	13.20 (Nevada)
28	12.45 (Louisiana)	58.23 (Washington)	13.11 (Michigan)
29	12.09 (Maine)	51.60 (Texas)	12.85 (North Dakota)
30	12.01 (Oklahoma)	50.93 (Mississippi)	12.78 (Ohio)
31	11.99 (Wisconsin)	50.82 (Vermont)	12.63 (Missouri)
32	11.92 (Indiana)	50.14 (Iowa)	12.63 (South Carolina)
33	11.46 (Kansas)	40.81 (Oklahoma)	12.61 (Pennsylvania)
34	11.42 (Missouri)	40.47 (Arkansas)	12.58 (Alabama)
35	11.32 (Michigan)	33.07 (Maine)	12.47 (North Carolina)
36	11.29 (South Dakota)	28.53 (Kansas)	12.35 (South Dakota)
37	11.21 (Rhode Island)	26.08 (Colorado)	12.33 (Maine)
38	11.07 (North Dakota)	25.04 (Oregon)	12.02 (Louisiana)
39	10.45 (Illinois)	22.91 (Arizona)	11.57 (Iowa)
40	10.13 (Ohio)	16.21 (Utah)	11.39 (Indiana)
41	10.07 (Montana)	10.38 (New Mexico)	10.87 (Tennessee)
42	9.72 (Iowa)	9.10 (North Dakota)	10.69 (Mississippi)
43	9.65 (New York)	8.97 (South Dakota)	10.11 (Kentucky)
44	9.65 (Pennsylvania)	7.18 (Nevada)	9.41 (West Virginia)
45	8.38 (West Virginia)	5.20 (Montana)	9.26 (Arkansas)
Mean	14.22	158.74	14.36
Std. Dev.	*3.77*	*211.55*	*2.73*

NOTE: The state-specific values reported in the table consist of the average value of that variable over the 8, five-year period observations from 1960-64 to 1995-99. 45 states are included in the sample: Hawaii, Alaska, Nebraska, Minnesota, and Wyoming are excluded for reasons discussed in the text.

TABLE V.1.B:
Rank Ordering of State Values for *Elderly*, *Farm*, and *Manufacturing*

RANK	*Elderly*	*Farm*	*Manufacturing*
1	15.05 (Florida)	12.63 (South Dakota)	30.02 (Michigan)
2	13.45 (Arkansas)	11.35 (North Dakota)	28.99 (Delaware)
3	13.35 (Iowa)	8.07 (Idaho)	28.97 (Indiana)
4	12.70 (Missouri)	7.93 (Iowa)	27.41 (Ohio)
5	12.65 (South Dakota)	6.23 (Montana)	24.64 (Wisconsin)
6	12.57 (Rhode Island)	6.03 (Arkansas)	24.05 (Connecticut)
7	12.47 (Kansas)	4.63 (Mississippi)	23.66 (South Carolina)
8	12.41 (Pennsylvania)	4.57 (Kansas)	23.48 (North Carolina)
9	12.16 (Massachusetts)	3.57 (North Carolina)	23.23 (Pennsylvania)
10	12.11 (Maine)	3.33 (Kentucky)	21.77 (Tennessee)
11	12.11 (West Virginia)	3.23 (Vermont)	21.09 (New Hampshire)
12	11.97 (Oklahoma)	2.92 (Oklahoma)	21.00 (Illinois)
13	11.76 (North Dakota)	2.92 (Wisconsin)	20.81 (Rhode Island)
14	11.61 (New York)	2.78 (New Mexico)	20.31 (Massachusetts)
15	11.57 (Wisconsin)	2.35 (Oregon)	19.88 (New Jersey)
16	11.50 (Oregon)	2.34 (Washington)	19.53 (Alabama)
17	11.17 (Connecticut)	2.31 (Alabama)	19.04 (Missouri)
18	11.17 (Vermont)	2.30 (Colorado)	19.03 (Vermont)
19	11.01 (New Jersey)	2.24 (Arizona)	18.77 (Maine)
20	10.97 (Kentucky)	2.21 (Georgia)	17.53 (Kentucky)
21	10.91 (New Hampshire)	2.18 (Missouri)	17.45 (Mississippi)
22	10.81 (Illinois)	2.16 (Maine)	17.34 (Georgia)
23	10.69 (Mississippi)	2.09 (Indiana)	17.18 (West Virginia)
24	10.69 (Montana)	2.02 (Texas)	17.08 (Oregon)
25	10.66 (Ohio)	1.97 (Florida)	16.96 (Arkansas)
26	10.57 (Indiana)	1.97 (South Carolina)	16.87 (Iowa)

RANK	*Elderly*	*Farm*	*Manufacturing*
27	10.57 (Tennessee)	1.84 (California)	16.37 (New York)
28	10.47 (Alabama)	1.75 (Tennessee)	16.17 (Washington)
29	10.26 (Washington)	1.70 (Louisiana)	15.36 (California)
30	9.87 (Idaho)	1.47 (Delaware)	13.95 (Kansas)
31	9.70 (Michigan)	1.42 (Illinois)	13.87 (Texas)
32	9.47 (California)	1.30 (Utah)	13.08 (Virginia)
33	9.42 (Arizona)	1.14 (Virginia)	12.79 (Utah)
34	9.39 (Delaware)	0.94 (Ohio)	12.38 (Idaho)
35	9.31 (North Carolina)	0.84 (Michigan)	12.21 (Louisiana)
36	9.16 (Louisiana)	0.83 (Nevada)	11.92 (Oklahoma)
37	8.92 (Texas)	0.67 (Pennsylvania)	11.45 (Maryland)
38	8.77 (Virginia)	0.65 (Maryland)	11.26 (Colorado)
39	8.76 (Maryland)	0.59 (New Hampshire)	11.08 (Arizona)
40	8.65 (Colorado)	0.52 (West Virginia)	8.20 (Florida)
41	8.60 (Georgia)	0.42 (Connecticut)	6.89 (Montana)
42	8.57 (South Carolina)	0.39 (New York)	6.55 (South Dakota)
43	7.95 (New Mexico)	0.31 (New Jersey)	5.05 (New Mexico)
44	7.36 (Nevada)	0.26 (Massachusetts)	4.09 (North Dakota)
45	7.35 (Utah)	0.24 (Rhode Island)	3.61 (Nevada)
Mean	10.68	2.75	16.94
Std. Dev.	1.70	2.74	6.59

NOTE: The state-specific values reported in the table consist of the average value of that variable over the 8, five-year period observations from 1960-64 to 1995-99. 45 states are included in the sample: Hawaii, Alaska, Nebraska, Minnesota, and Wyoming are excluded for reasons discussed in the text.

TABLE V.2.A:
Regression Results (Dependent Variable = *Growth of Real PCPI*)

VARIABLES[a]	OLS[b] (1)	OLS-HCSE[b] (2)	OLS-PCSE[b] (3)	2SLS[b] (4)	2SLS-PCSE[b] (5)
Change in Tax Rate	-3.4842 (-7.31)	-3.4842 (-4.07)	-3.4842 (-4.49)	-3.4764 (-2.09)	-3.4764 (-1.73)
Initial Tax Rate	-1.4965 (-3.12)	-1.4965 (-2.44)	-1.4965 (-2.25)	-1.4926 (-1.59)	-1.4926 (-1.23)
Initial Income	-0.1004 (-3.83)	-0.1004 (-3.50)	-0.1004 (-2.38)	-0.1004 (-3.82)	-0.1004 (-2.35)
Density	-0.0298 (-1.69)	-0.0298 (-1.89)	-0.0298 (-1.74)	-0.0298 (-1.58)	-0.0298 (-1.45)
Education	0.5324 (2.73)	0.5324 (2.92)	0.5324 (2.43)	0.5328 (2.51)	0.5328 (2.14)
Elderly	0.7834 (1.83)	0.7834 (1.88)	0.7834 (1.62)	0.7843 (1.67)	0.7843 (1.36)
Farm	-0.2798 (-1.76)	-0.2798 (-0.87)	-0.2798 (-0.77)	-0.2792 (-1.40)	-0.2792 (-0.46)
Manufacturing	0.1177 (0.67)	0.1177 (0.52)	0.1177 (0.38)	-0.1182 (-0.56)	-0.1182 (-0.35)

VARIABLES[a]	OLS[b] (1)	OLS-HCSE[b] (2)	OLS-PCSE[b] (3)	2SLS[b] (4)	2SLS-PCSE[b] (5)
Other Control Variables	State Fixed Effects Time Fixed Effects	State Fixed Effects Time Fixed Effects	State Fixed Effects Time Fixed Effects	State Fixed Effects Time Fixed Effects	State Fixed Effects Time Fixed Effects
Observations	0360	360	360	360	360
R^2 ***(Adjusted R^2)***	0.6533 (0.5852)	0.6533 (0.5852)	0.6533 (0.5852)	----	----
<u>HYPOTHESIS TESTS</u>					
Significance of Tax Variables[c]	$F = 26.954$ (p-value = 0.0001)	$F = 8.498$ (p-value = 0.0003)	$F = 28.262$ (p-value = 0.0001)	$F = 2.377$ (p-value = 0.0090)	$F = 33.917$ (p-value =0.0001)
Significance of State Fixed Effects[d]	$F = 3.965$ (p-value = 0.0001)	$F = 6.740$ (p-value = 0.0001)	$F = 5.134$ (p-value = 0.0001)	$F = 3.963$ (p-value = 0.0001)	$F = 9.384$ (p-value = 0.0001)
Significance of Time Fixed Effects[e]	$F = 11.504$ (p-value = 0.0001)	$F = 15.454$ (p-value = 0.0001)	$F = 12.042$ (p-value = 0.0001)	$F = 11.198$ (p-value = 0.0001)	$F = 21.079$ (p-value = 0.0001)
Hausman Test[f]	----	----	----	$t = 0.05$ (p-value = 0.9607)	$t = 0.05$ (p-value = 0.9607)
1st Stage Test of Excluded Instruments[g]	----	----	----	$F = 4.219$ (p-value = 0.0009)	$F = 4.219$ (p-value = 0.0009)
2nd Stage Test of Excluded Instruments[h]	----	----	----	$\chi^2 = 14.004$ (p-value = 0.0156)	$\chi^2 = 14.004$ (p-value = 0.0156)

Notes:

[a] Variables are described in the text. State-specific values of some of the variables are reported in TABLE V.1.A and V.1.B.

[b] *t*-statistics are reported in parentheses below the coefficient estimates.

[c] The corresponding null hypothesis is $\beta_{Change\ in\ Tax\ Rate} = \beta_{Initial\ Tax\ Rate} = 0$.

[d] The corresponding null hypothesis is that the 45 state fixed effects are jointly equal to zero.

[e] The corresponding null hypothesis is that the 7 time-period fixed effects are jointly equal to zero.

[f] The excluded instruments are ***ADA Average***, ***Democratic Legislature***, and ***Republican Legislature***. These variables are described in Chapter IV.

[g] The null hypothesis is that $\beta_{ADA\ Average} = \beta_{Democratic\ Legislature} = \beta_{Republican\ Legislature} = 0$ in a regression equation in which ***Change in Tax Rate*** is the dependent variable and the explanatory variables consist of the 58 exogenous variables included in the first specification, plus the three political variables (cf. Section V.5 in the text).

[h] The null hypothesis is that $\beta_{ADA\ Average} = \beta_{Democratic\ Legislature} = \beta_{Republican\ Legislature} = 0$ in a regression equation in which the dependent variable is the vector of residuals from the original (endogenous) equation, and the explanatory variables consist of the full set of instruments (cf. Section V.5 in the text).

TABLE V.2.B:
Regression Results (Dependent Variable = *Growth of Real PCPI*)

VARIABLES[a]	OLS[b] (1)	OLS-HCSE[b] (2)	OLS-PCSE[b] (3)	2SLS[b] (4)	2SLS-PCSE[b] (5)
Change in Tax Rate	-1.9787	-1.9787	-1.9787	-5.1060	-5.1060
	(-4.13)	(-3.45)	(-3.65)	(-2.78)	(-3.01)
Initial Tax Rate	-1.5922	-1.5922	-1.5922	-3.132	-3.1323
	(-3.47)	(-3.21)	(-3.33)	(-3.14)	(-3.44)
Initial Income	-0.0971	-0.0971	-0.0971	-0.0847	-0.0847
	(-3.42)	(-3.37)	(-2.46)	(-2.71)	(-2.07)
Density	-0.0206	-0.0206	-0.0206	-0.0210	-0.0210
	(-0.99)	(-0.98)	(-1.25)	(-0.93)	(-1.23)
Education	0.4675	0.4675	0.4675	0.4107	0.4107
	(2.54)	(2.54)	(2.62)	(2.05)	(2.11)
Elderly	0.4383	0.4383	0.4383	0.2370	0.2370
	(1.11)	(1.06)	(0.90)	(0.54)	(0.45)
Farm	-1.0184	-1.0184	-1.0184	-1.0162	-1.0162
	(-1.15)	(-1.45)	(-1.73)	(-1.07)	(-1.73)
Manufacturing	0.4291	0.4291	0.4291	-0.3060	-0.3060
	(1.57)	(1.67)	(1.26)	(-1.01)	(-0.90)

VARIABLES[a]	OLS[b] (1)	OLS-HCSE[b] (2)	OLS-PCSE[b] (3)	2SLS[b] (4)	2SLS-PCSE[b] (5)
Other Control Variables	State Fixed Effects Time Fixed Effects Interaction Effects[c]	State Fixed Effects Time Fixed Effects Interaction Effects[c]	State Fixed Effects Time Fixed Effects Interaction Effects[c]	State Fixed Effects Time Fixed Effects Interaction Effects[c]	State Fixed Effects Time Fixed Effects Interaction Effects[c]
Observations	360	360	360	360	360
R^2 (Adjusted R^2)	0.7743 (0.7096)	0.7743 (0.7096)	0.7743 (0.7096)	----	----
<u>HYPOTHESIS TESTS</u>					
Significance of Tax Variables[d]	$F = 9.775$ (p-value = 0.0001)	$F = 7.028$ (p-value =0.0011)	$F = 10.045$ (p-value = 0.0001)	$F = 4.927$ (p-value = 0.0079)	$F = 15.582$ (p-value = 0.0001)
Significance of State Fixed Effects[e]	$F = 5.233$ (p-value = 0.0001)	$F = 9.578$ (p-value = 0.0001)	$F = 6.366$ (p-value = 0.0001)	$F = 4.609$ (p-value = 0.0001)	$F = 10.470$ (p-value = 0.0001)
Significance of Time Effects[f]	$F = 4.195$ (p-value = 0.0001)	$F = 3.325$ (p-value = 0.0001)	$F = 4.311$ (p-value = 0.0001)	$F = 4.002$ (p-value = 0.0001)	$F = 7.221$ (p-value = 0.0001)
Significance of Time Interaction Effects[g]	$F = 7.118$ (p-value = 0.0001)	$F = 10.336$ (p-value = 0.0001)	$F = 7.315$ (p-value = 0.0001)	$F = 4.880$ (p-value = 0.0001)	$F = 12.176$ (p-value = 0.0001)
Hausman Test[h]	----	----	----	$t = 1.91$ (p-value = 0.0569)	$t = 1.91$ (p-value = 0.0569)

VARIABLES[a]	OLS[b] (1)	OLS-HCSE[b] (2)	OLS-PCSE[b] (3)	2SLS[b] (4)	2SLS-PCSE[b] (5)
1[st] Stage Test of Excluded Instruments[i]	----	----	----	$F = 3.653$ (p-value = 0.0017)	$F = 3.653$ (p-value = 0.0017)
2[nd] Stage Test of Excluded Instruments[j]	----	----	----	$\chi^2 = 19.044$ (p-value = 0.0019)	$\chi^2 = 19.044$ (p-value = 0.0019)

Notes:

[a] Variables are described in the text. State-specific values of some of the variables are reported in TABLE V.1.A and V.1.B.

[b] t-statistics are reported in parentheses below the coefficient estimates.

[c] The variables ***Density, Farm***, and ***Manufacturing*** are each interacted with the 7 time period dummy variables, resulting in a total of 21 (time) interaction effects.

[d] The corresponding null hypothesis is $\beta_{Change\ in\ Tax\ Rate} = \beta_{Initial\ Tax\ Rate} = 0$.

[e] The corresponding null hypothesis is that the 45 state fixed effects are jointly equal to zero.

[f] The corresponding null hypothesis is that the 7 time-period fixed effects are jointly equal to zero, along with the 21 time interaction effects (cf. Note (c) above).

[g] The corresponding null hypothesis is that the 21 time interaction effects are jointly equal to zero (cf. Note (c) above).

[h] The excluded instruments are ***ADA Average***, ***Democratic Legislature***, ***Republican Legislature***; ***ADA Average*** × ***Farm***, ***Democratic Legislature*** × ***Farm***, and ***Republican Legislature*** × ***Farm***.

[i] The null hypothesis is that the six political variables (cf. Note (h) above) are jointly equal to zero in a regression equation in which ***Change in Tax Rate*** is the dependent variable and the explanatory variables consist of the 79 exogenous variables included in the second specification, plus the six political variables (cf. Section V.5 in the text).

[j] The null hypothesis is that the six political variables (cf. Note (h) above) are jointly equal to zero in a regression equation in which the dependent variable is the vector of residuals from the original (endogenous) equation, and the explanatory variables consist of the full set of instruments (cf. Section V.5 in the text).

Table V.3 Two-Stage Least Squares Results (Dependent Variable = *Growth of Real PCPI*)

VARIABLES[a]	2SLS[b] (1)	2SLS w/o Democrat[b] (2)	2SLS[b] (3)	2SLS w/o Democrat [b] (4)
Change in Tax Rate	-3.4764 (-2.09)	-0.1204 (-0.05)	-5.1060 (-2.78)	-1.7353 (-0.78)
Initial Tax Rate	-1.4926 (-1.59)	0.2035 (-0.171)	-3.132 (-3.14)	-1.4723 (-1.27)
Initial Income	-0.1004 (-3.82)	-0.1049 (-3.69)	-0.0847 (-2.71)	-0.0981 (-3.30)
Density	-0.0298 (-1.58)	-0.0441 (-2.10)	-0.0210 (-0.93)	-0.0206 (-0.98)
Education	0.5328 (2.51)	0.7054 (2.97)	0.4107 (2.05)	0.4718 (2.50)
Elderly	0.7843 (1.67)	1.1917 (2.25)	0.2370 (0.54)	0.4540 (1.08)
Farm	-0.2792 (-1.40)	-0.0248 (-0.10)	-1.0162 (-1.07)	-1.0186 (-1.15)
Manufacturing	-0.1182 (-0.56)	0.3632 (1.48)	-0.3060 (-1.01)	0.4387 (1.53)
Other Control Variables	State Fixed Effects Time Fixed Effects	State Fixed Effects Time Fixed Effects	State Fixed Effects Time Fixed Effects Interaction Effects[c]	State Fixed Effects Time Fixed Effects Interaction Effects[c]

VARIABLES[a]	2SLS[b] (1)	2SLS w/o Democrat[b] (2)	2SLS[b] (3)	2SLS w/o Democrat[b] (4)
Observations	360	360	360	360
Significance of Tax Variables[d]	$F = 3.015$ (p-value = 0.050)	$F = 0.1741$ (p-value = 0.8402)	$F = 4.927$ (p-value = 0.0079)	$F = 2.193$ (p-value = 0.1135)
Hausman Test[e]	$t = 0.05$ (p-value = 0.9607)	$t = 1.718$ (p-value = 0.0868)	$t = 1.91$ (p-value = 0.0569)	$t = 0.113$ (p-value = 0.9100)
1st Stage Test of Excluded Instruments[f]	$F = 4.219$ (p-value = 0.0009)	$F = 4.137$ (p-value = 0.0028)	$F = 3.653$ (p-value = 0.0017)	$F = 3.086$ (p-value = 0.0166)
2nd Stage Test of Excluded Instruments[g]	$\chi^2 = 14.004$ (p-value = 0.0156)	$\chi^2 = 6.408$ (p-value =0.2685)	$\chi^2 = 19.044$ (p-value = 0.0019)	$\chi^2 = 6.948$ (p-value =0.2245)

Notes:

[a] Variables are described in the text. State-specific values of some of the variables are reported in TABLE V.1.A and V.1.B.

[b] t-statistics are reported in parentheses below the coefficient estimates.

[c] The variables ***Density***, ***Farm***, and ***Manufacturing*** are each interacted with the 7 time period dummy variables, resulting in a total of 21 (time) interaction effects.

[d] The corresponding null hypothesis is $\beta_{Change\ in\ Tax\ Rate} = \beta_{Initial\ Tax\ Rate} = 0$.

CHAPTER VI
CONCLUSION

VI.1. Introduction

The goal of this dissertation has been to empirically investigate the effect of taxes on state economic growth. As discussed in Chapter III, innovations in my approach include (i) an attempt to correct for endogeneity between state economic growth and state tax rates, and (ii) application of a wide variety of statistical techniques to address non-spherical error structures. I utilize economic, demographic, and political data on forty-five states (omitting Alaska, Hawaii, Nebraska, Minnesota, and Wyoming) from 1960 to 1999. My major finding is that state taxes are negatively and significantly related to state economic growth.

As discussed in Chapter V, I find that taxes exert a negative influence on growth in two respects. Holding constant their initial tax rates, I find that states that increase taxes within a five-year period have slower growth during that period than states that do not increase taxes. Further, holding constant changes in tax rates, I find that states with higher initial tax rates have slower economic growth in subsequent years. Putting these two estimated effects together, I conclude that tax increases have both short- and long-run negative effects on growth.

My results contribute to a large empirical literature on the relationship between taxes and economic growth. As discussed in Chapter II, while most country studies find a negative and statistically significant relationship between taxes and growth, studies of U.S. states have generally reported a statistically insignificant and sometimes positive relationship between these two variables.

In addition to my findings on taxes affect growth, I also find that political variables are important determinants of state tax rates. As discussed in Chapter IV, I conclude that states with more liberal federal legislators are more likely to increase taxes. Further, states in which Republicans control both houses of the state legislature are less likely to raise taxes during that period than states in which control of the state legislature is split between the two parties. States in which Democrats control both houses of the state legislature are more likely to raise taxes.

VI.2. Limitations

Methodologically, this study is the first to apply Beck and Katz's (1995) Panel Corrected Standard Error (PCSE) approach to estimate standard errors in the context of estimating the effect of taxes on state economic growth. As discussed in Chapter III, standard GLS techniques are unable to incorporate cross-sectional correlation (that is, correlations in the errors between states) because the number of time series observations is less than the number of group (state) observations. Accordingly, the PCSE approach is the only way to incorporate cross-sectional correlation in the estimation of standard errors.

Unfortunately, I had to omit two states (Nebraska and Minnesota) because of missing values of the political variables for in my sample period.[23] The PCSE approach requires that the sample data be rectangular (all cross-sectionals have the same time-series), thus I must have no missing data. However, there is another procedure that I could have used to address this problem. Franzese (1996) has a GAUSS program that can be downloaded from the internet that allows one to apply the PCSE procedure to non-

[23] State of Nebraska has a unicameral legislature. Minnesota had legislatures who served on non-partisan basis from 1959 to 1970. I need these political variables to perform the 2SLS estimates and further to handle the endogeneity problem

rectangular data.[24] Had I become familiar with GAUSS, I could have expanded my empirical analysis to include Nebraska and Minnesota. Given the robustness of my results, I have no reason to suspect that the addition of two states to my current sample of forty-five states would alter my conclusions. Nevertheless, this would be a useful extension to explore in future research.

Another limitation of my research concerns the use of instrumental variables. As discussed in Chapter V, endogeneity in the tax variables is a potentially serious problem. Thus, it is crucial to find good instruments for the change in state tax rates. Accordingly, I applied a number of testing procedures to determine the reliability of my instruments. I conducted (i) a Hausman test of endogeneity, (ii) a partial F-test to determine the seriousness of finite sample bias associated with 2SLS (Bound and Jaeger, 1995), and (iii) a Bollen test to test for instrument endogeneity in the over-identified model. Most troubling was the result that, for some of my specifications, the Bollen test indicated that at least one of the excluded instruments is correlated with state economic growth. However, other specifications did not produce this result; and the estimated tax effects did not differ substantially between the specifications that produced this result and the ones that did not. Therefore, I do not believe my conclusions are seriously affected by this deficiency. Nevertheless, an exercise for future research would be to attempt to identify the endogenous instrument or instruments and re-estimate my results accordingly.

Despite these limitations, this study has met its purpose in addressing the endogeneity of taxes, finding instruments for state tax changes, and estimating the effects

[24] This econometrics procedure can be downloaded from: http://www.personal.umich.edu/~franzese/pcse.documentation.pdf

of taxes on the economic growth. In the process of doing so, it also brought forth evidence that demographic variables such as educational attainment also are important for state economic growth.

VI.3. Directions for Future Research

Future research could expand on the role of political structure, and the interaction of political structure and taxes, in affecting economic growth. This research could prove valuable to state and local governments, and political parties, in determining economic and fiscal policies. Such studies could potentially provide a more realistic picture of how local taxes and political structures combine to affect economic growth performance.

As discussed in Chapter II, a number of previous studies report that different kinds of taxes have different effects on economic growth. A state-level study by Romans and Subrahmanyan (1979) estimates that business taxes positively and significantly correlated with economic growth. Moreover, a country-level study by Mendoza, Milesi-Feretti, and Asea (1997) reports that consumption taxes are positively and significantly related to economic growth.

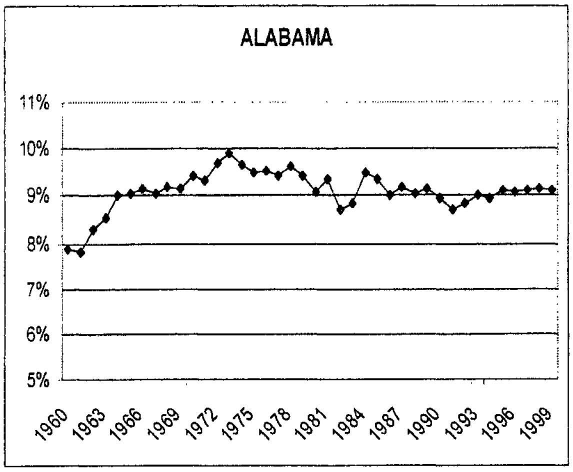
The structure of taxes composing tax burden variables may also have important effects on the magnitude of the dead-weight loss of taxes. In other word, a variable representing the structure of state tax systems could be incorporated in extension of my analysis. Given two states with the same tax burden, the one with the more optimal tax system should have higher growth. Accordingly, my research could be extended by: (i) decomposing taxes into different kinds of taxes to determine if they have different effects on growth; and (ii) adding a measure of the optimality of the state tax system into the analysis. In addition, differences in state tax regulation and legal structures may coincide with differences in taxes and growth.

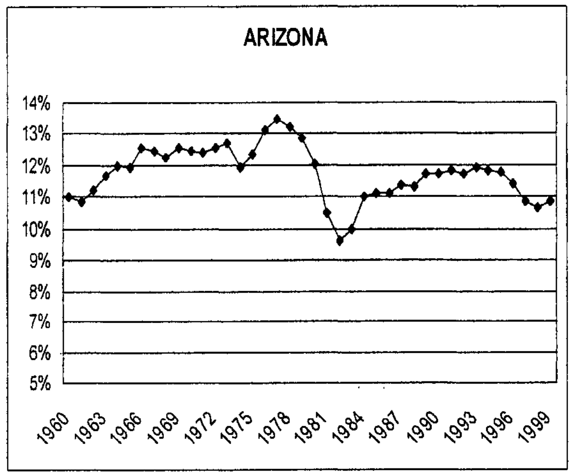
VI.4. Conclusion

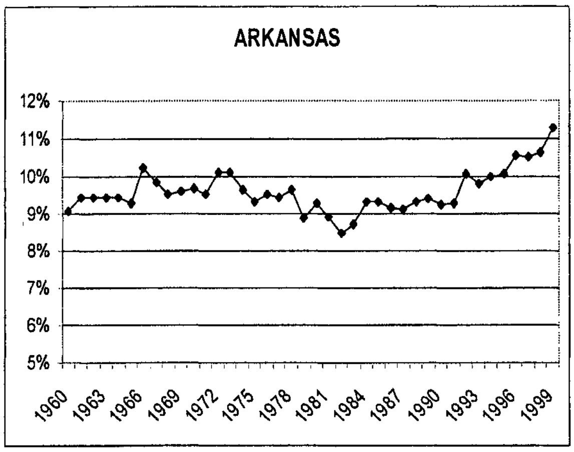
In conclusion, my study estimates that lower taxes positively impact economic growth. However, I want to emphasize that this result should not be interpreted as encouraging policy-makers to cut taxes without considering other useful programs needed for economic growth. Since educational attainment is found to have a significantly positive coefficient sign on economic growth, fiscal policy-makers need to ensure that tax revenues will be used to finance important social programs or infrastructures like education and health.

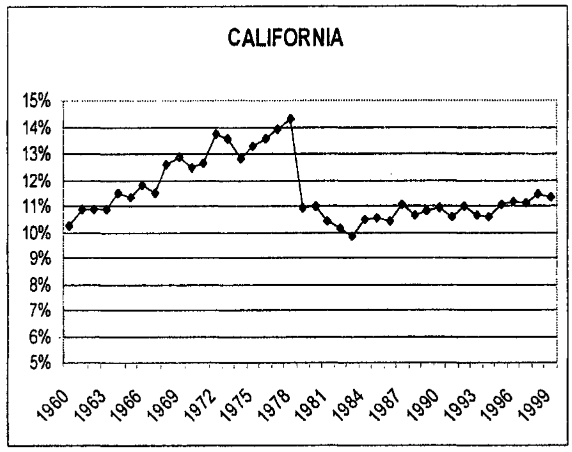
This study also finds that political structures at the state and federal level, along with demographic factors, influence the determination of taxes at the state and local level. In particular, my findings support the conventional wisdom that Democratic legislatures favor higher tax rates compared to Republicans. Future research can build on these findings by investigating the impacts of taxes on growth using more advanced simultaneous models and estimation procedures.

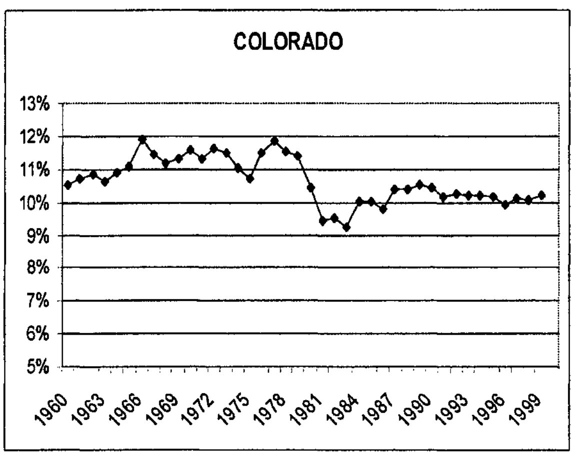
Appendix A: Individual State Time Series of Tax Burden: 1960-1999

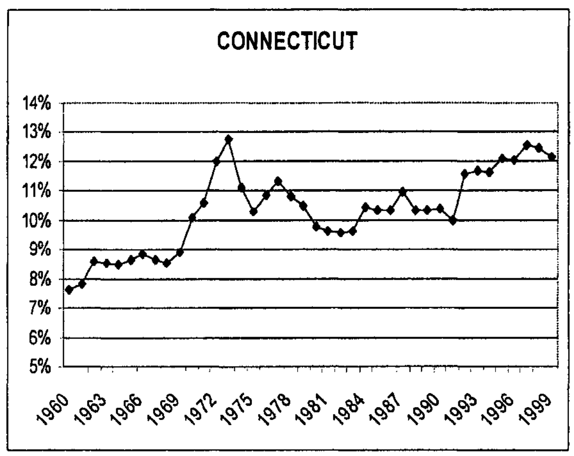












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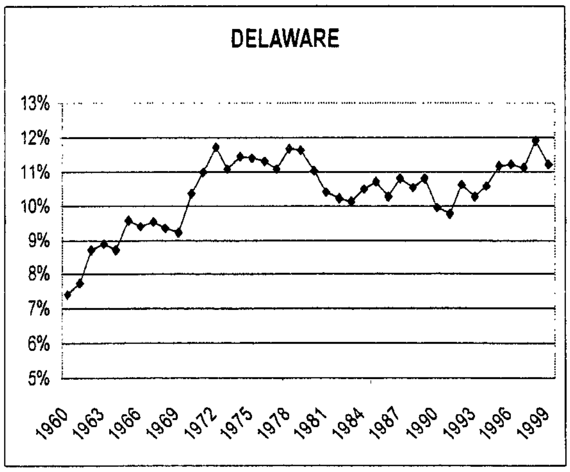
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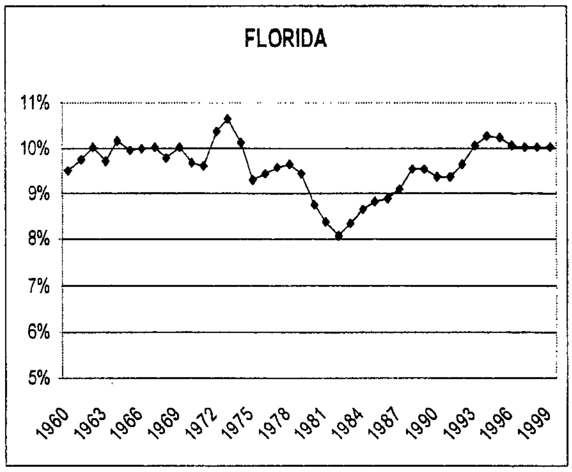
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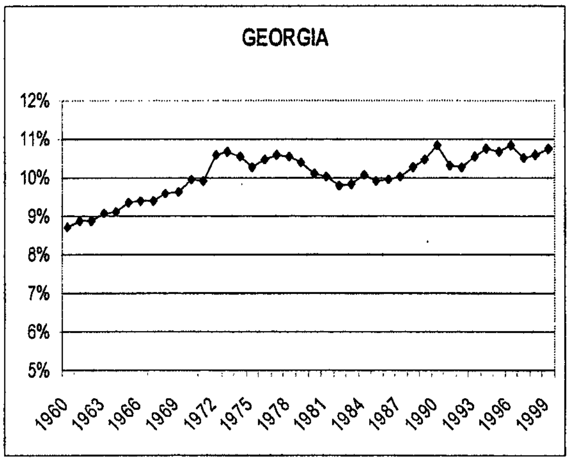
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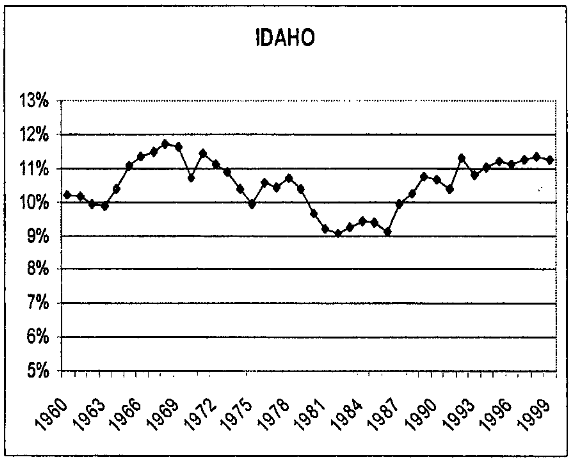
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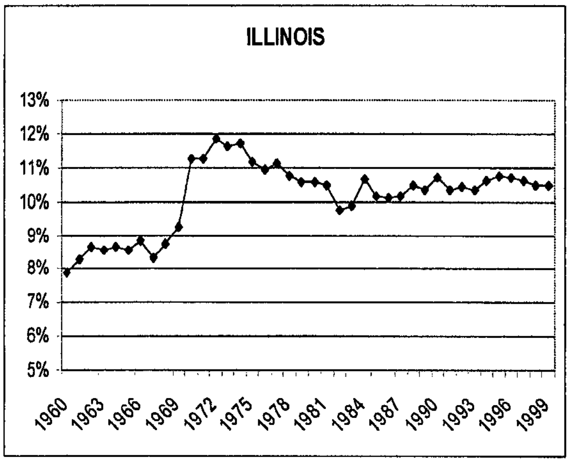
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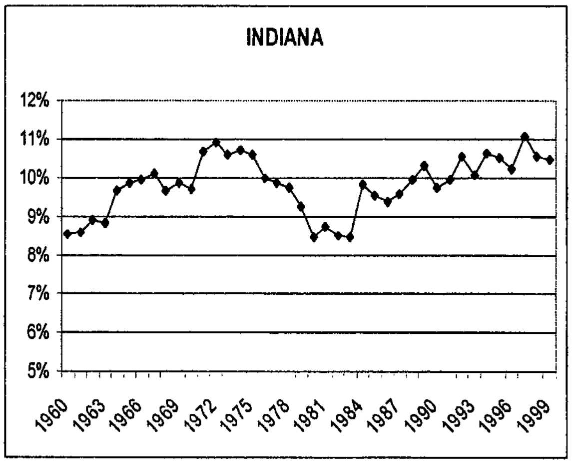
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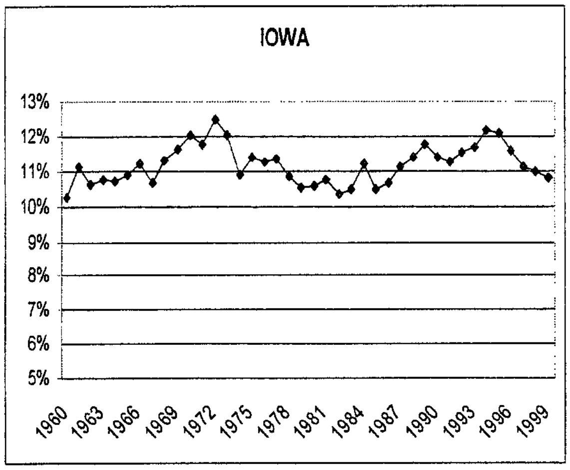
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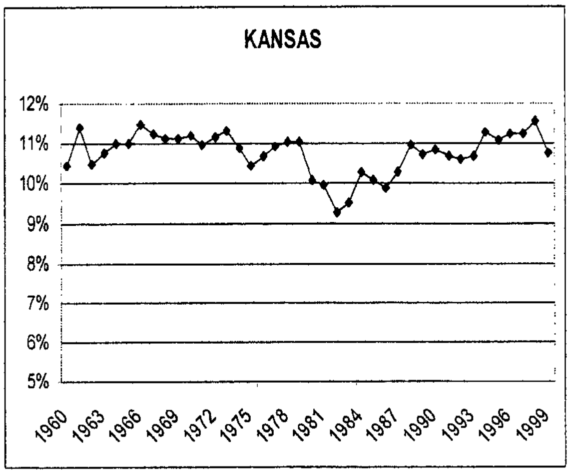
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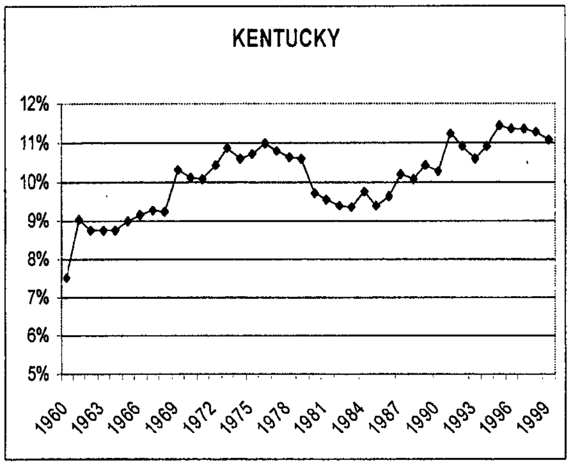
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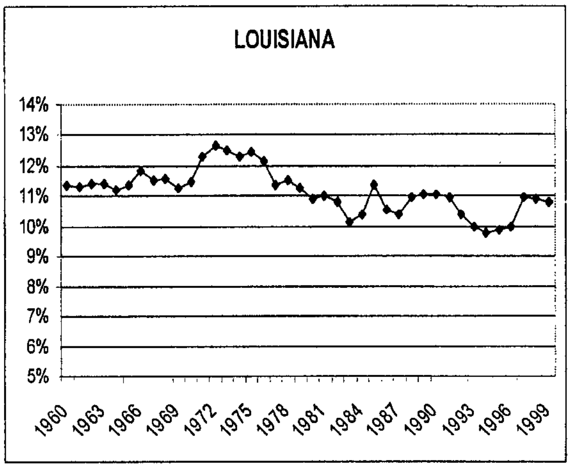
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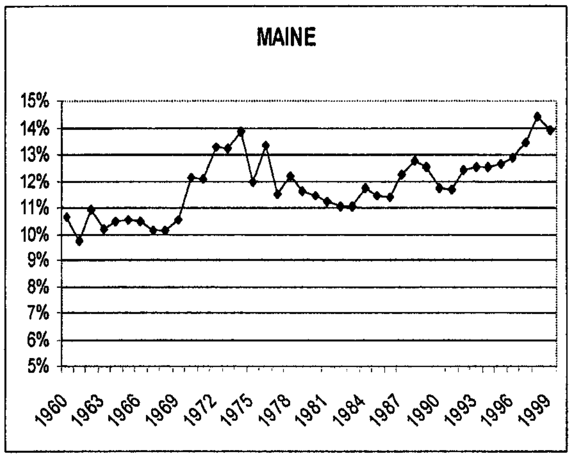
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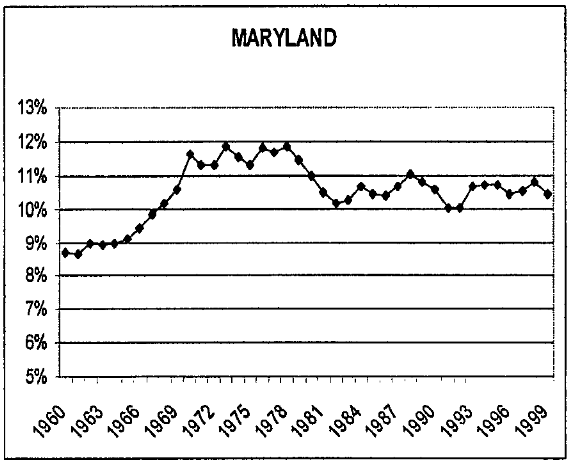
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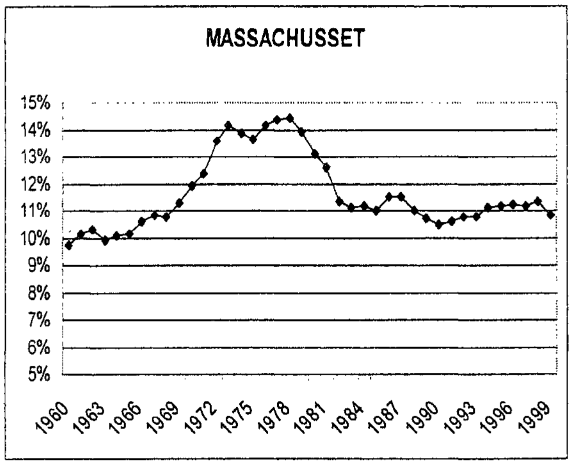
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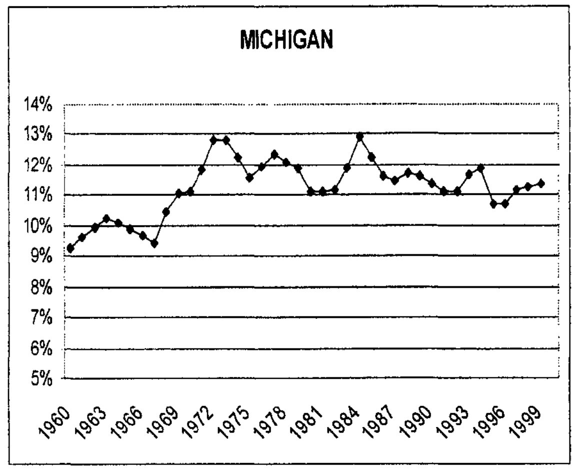
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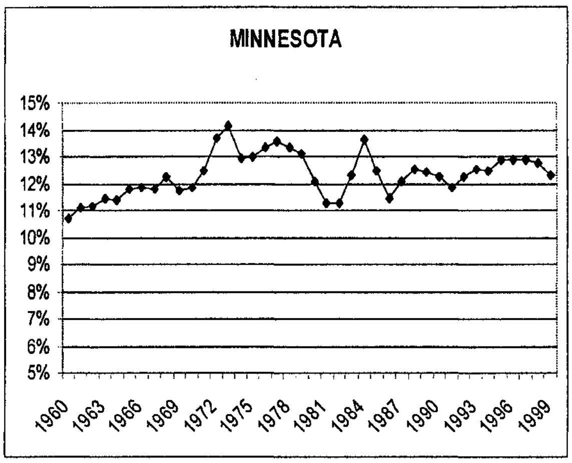
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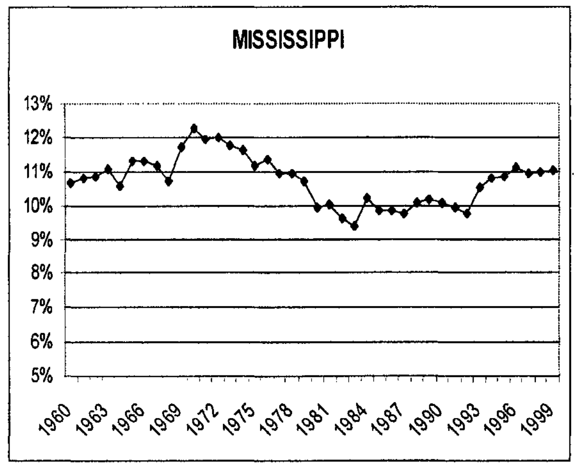
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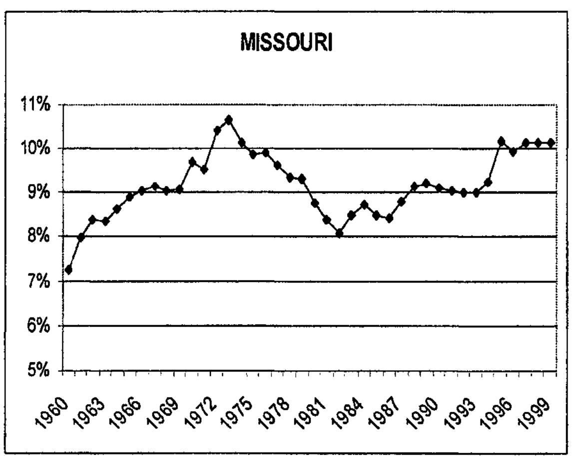
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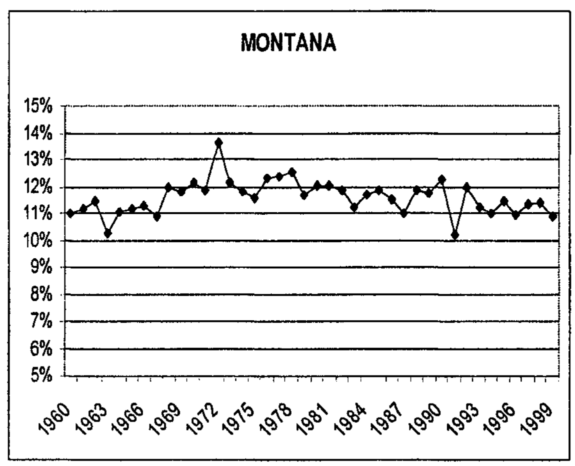
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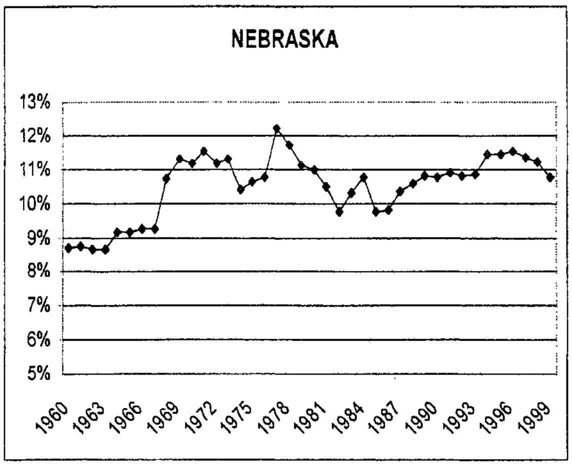
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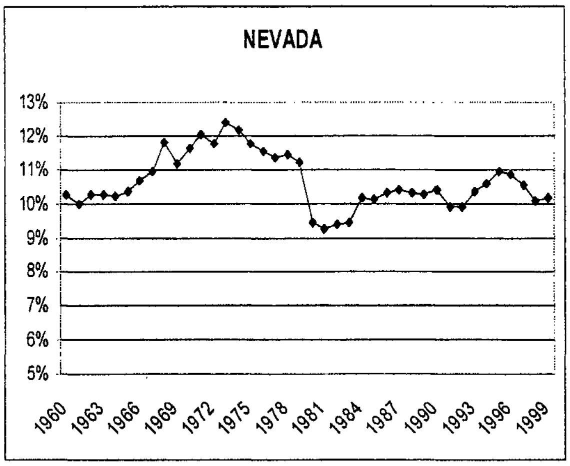
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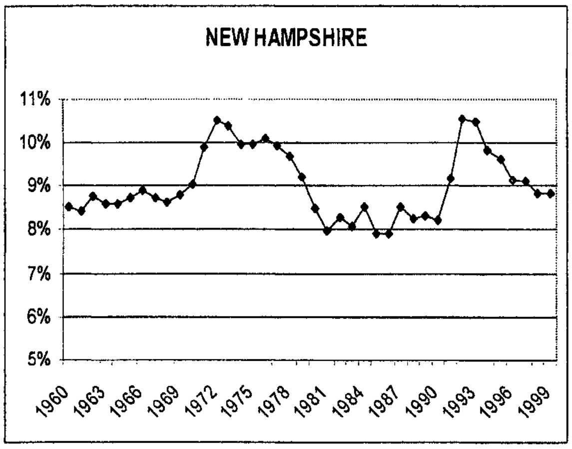
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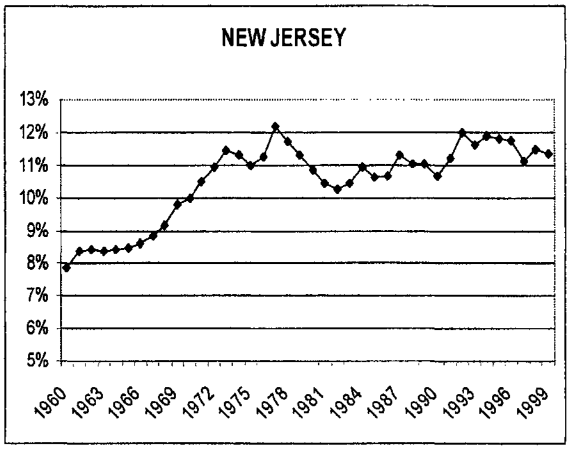
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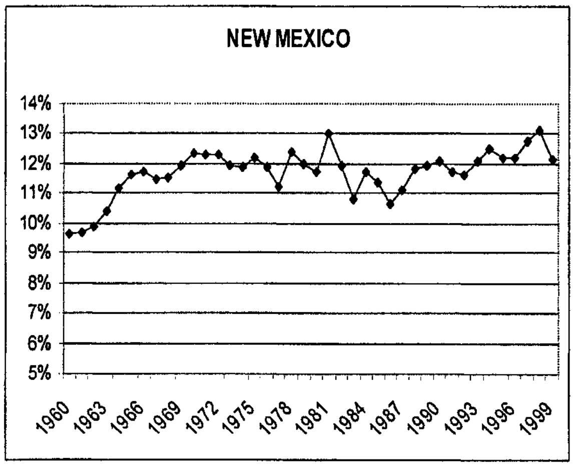
NEW MEXICO
14%
13%
12%
11%
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9%
8%
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5%
1960
1963
1966
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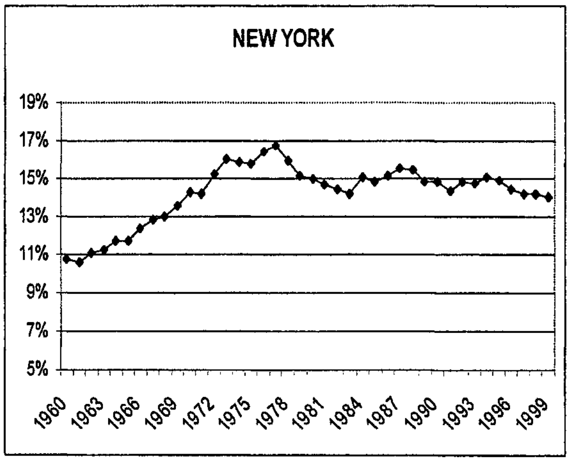
NEW YORK
19%
17%
15%
13%
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1960
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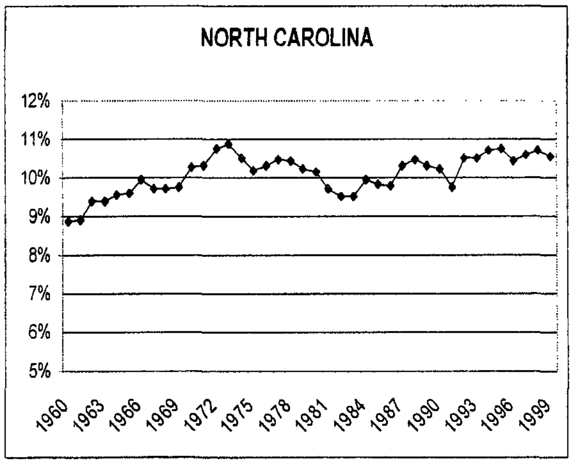
1999

continued ...



NORTH CAROLINA
12%
11%
10%
9%
8%
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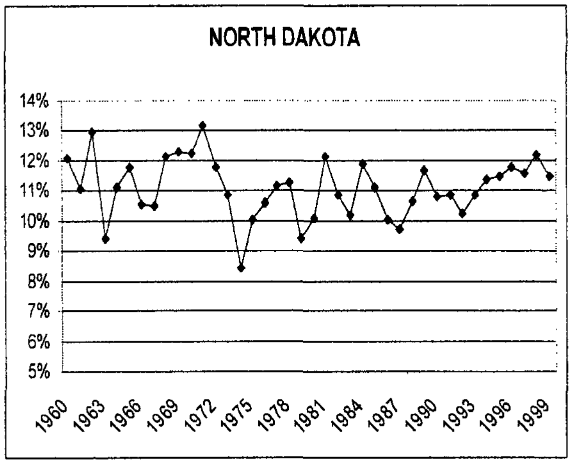
5%
1960 1963 1966 1969 1972 1975 1978 1981 1984 1987 1990 1993 1996 1999



NORTH DAKOTA
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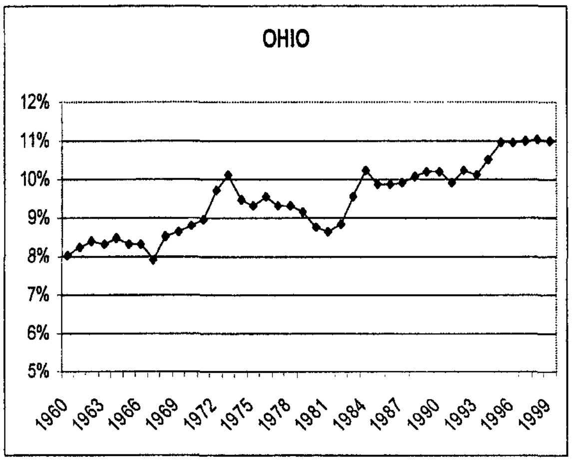
1960 1963 1966 1969 1972 1975 1978 1981 1984 1987 1990 1993 1996 1999



OHIO
12%
11%
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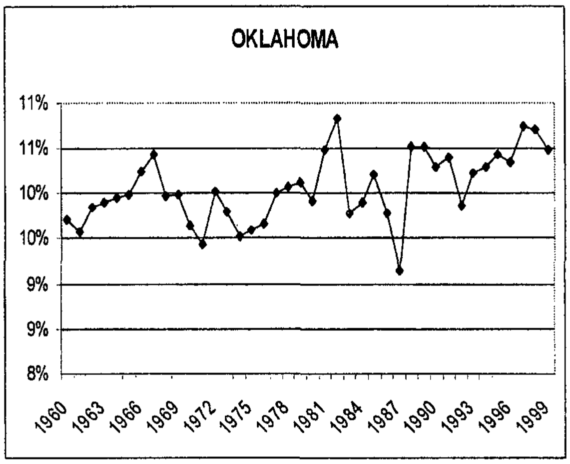
1960 1963 1966 1969 1972 1975 1978 1981 1984 1987 1990 1993 1996 1999



OKLAHOMA
11%
11%
10%
10%
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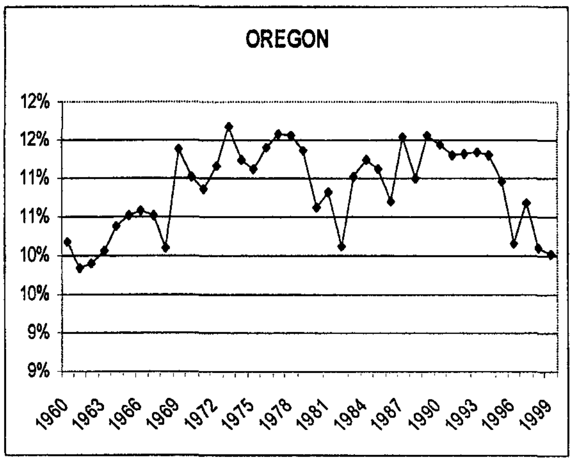
1960 1963 1966 1969 1972 1975 1978 1981 1984 1987 1990 1993 1996 1999



OREGON
12%
12%
11%
11%
10%
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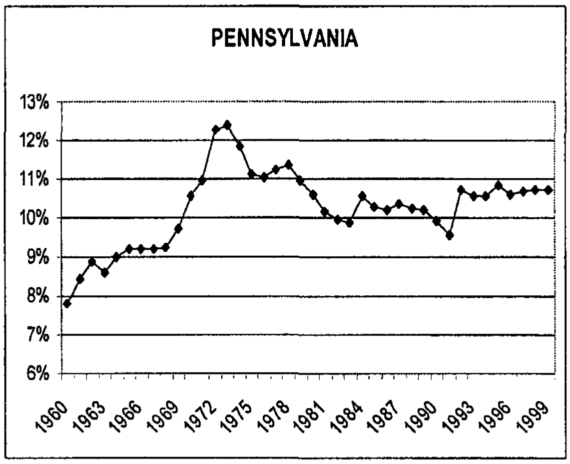
9%
1960 1963 1966 1969 1972 1975 1978 1981 1984 1987 1990 1993 1996 1999



PENNSYLVANIA
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12%
11%
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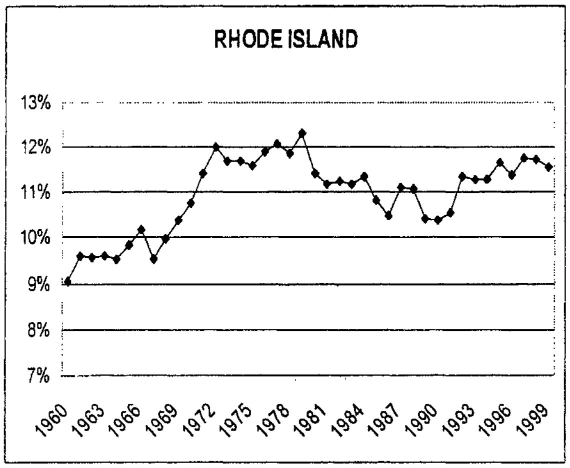
1960 1963 1966 1969 1972 1975 1978 1981 1984 1987 1990 1993 1996 1999

continued ...


RHODE ISLAND
13%
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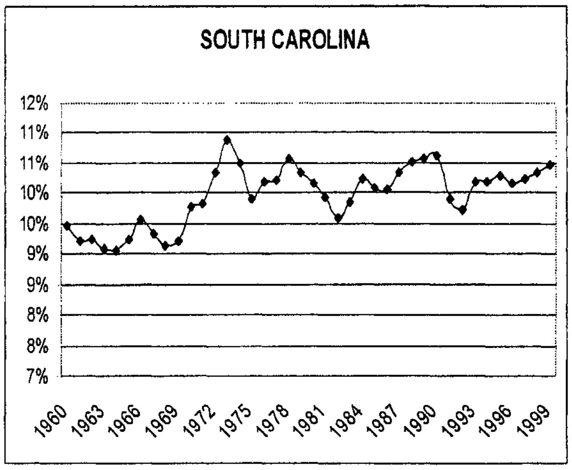
1960 1963 1966 1969 1972 1975 1978 1981 1984 1987 1990 1993 1996 1999


SOUTH CAROLINA
12%
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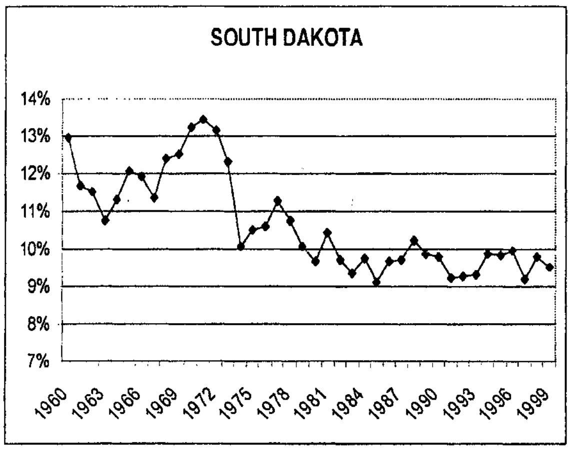
1960 1963 1966 1969 1972 1975 1978 1981 1984 1987 1990 1993 1996 1999


SOUTH DAKOTA
14%
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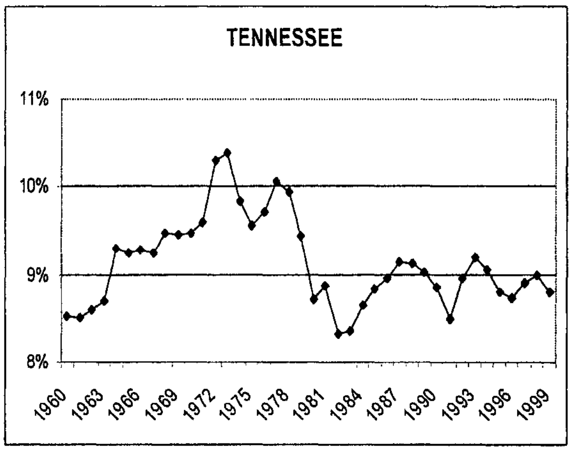
1960 1963 1966 1969 1972 1975 1978 1981 1984 1987 1990 1993 1996 1999


TENNESSEE
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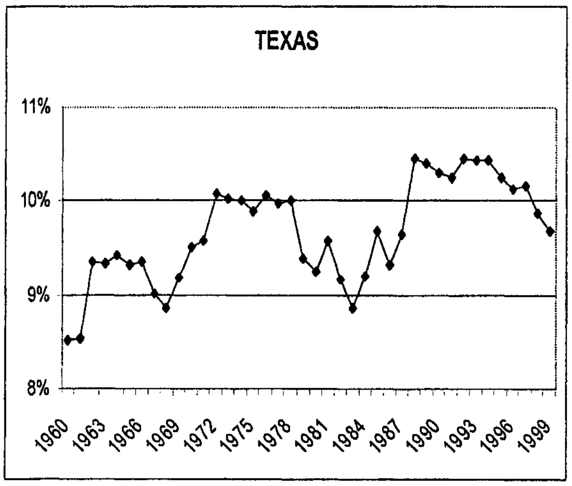
1960 1963 1966 1969 1972 1975 1978 1981 1984 1987 1990 1993 1996 1999


TEXAS
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10%
9%
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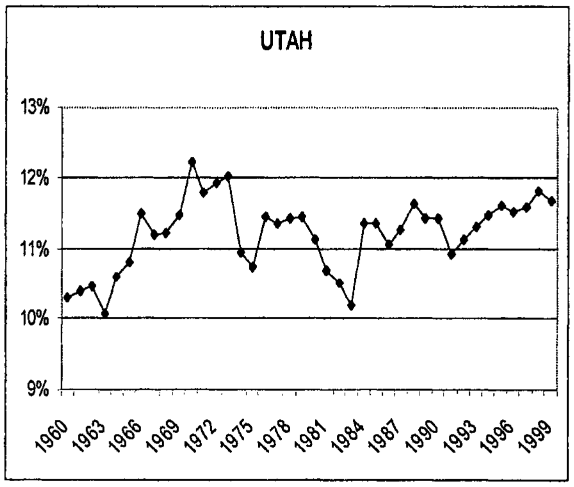
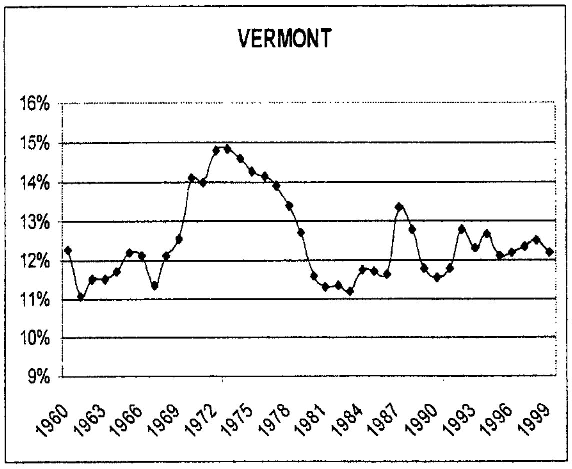
1960 1963 1966 1969 1972 1975 1978 1981 1984 1987 1990 1993 1996 1999


UTAH
13%
12%
11%
10%
9%
1960 1963 1966 1969 1972 1975 1978 1981 1984 1987 1990 1993 1996 1999

continued ...


VERMONT
16%
15%
14%
13%
12%
11%
10%
9%
1960
1963
1966
1969
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1981
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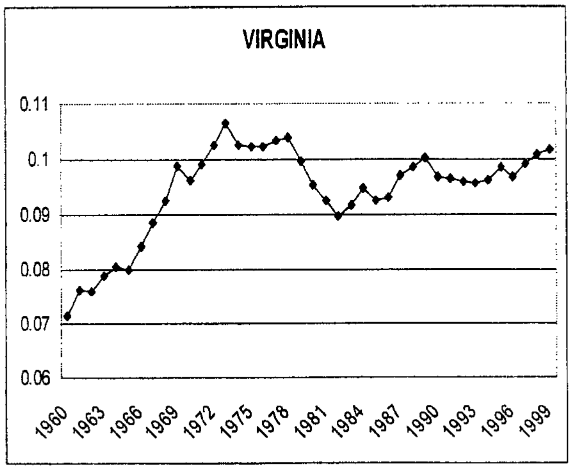
VIRGINIA
0.11
0.1
0.09
0.08
0.07
0.06
1960
1963
1966
1969
1972
1975
1978
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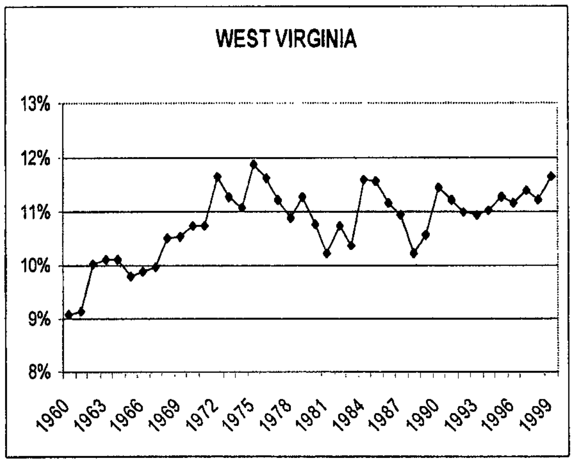
1987
1990
1993
1996
1999


WEST VIRGINIA
13%
12%
11%
10%
9%
8%
1960
1963
1966
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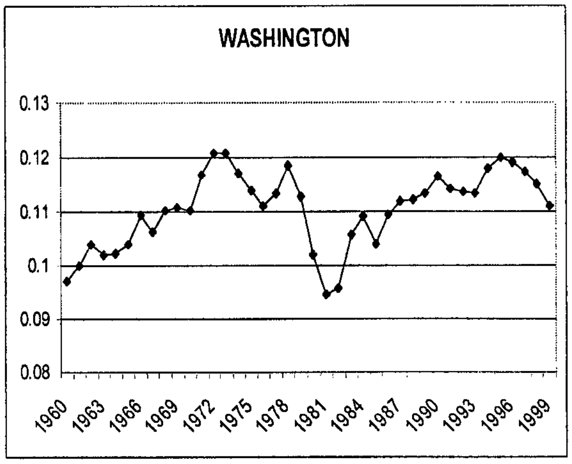
1993
1996
1999


WASHINGTON
0.13
0.12
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0.1
0.09
0.08
1960
1963
1966
1969
1972
1975
1978
1981
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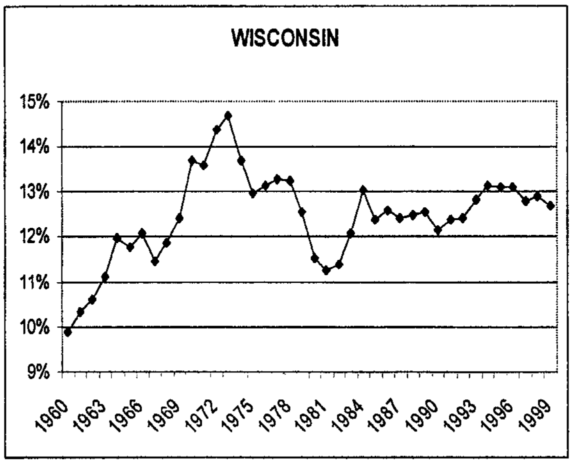
1987
1990
1993
1996
1999


WISCONSIN
15%
14%
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1960
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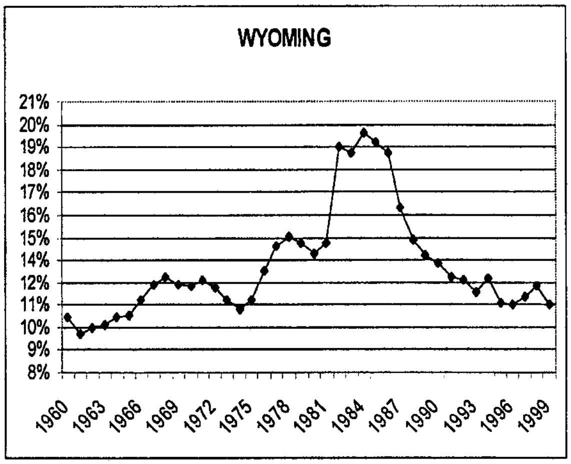
WYOMING
21%
20%
19%
18%
17%
16%
15%
14%
12%
11%
10%
9%
8%
1960
1963
1966
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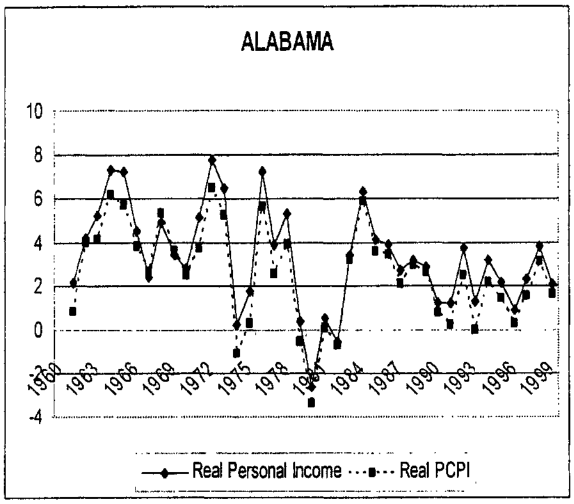
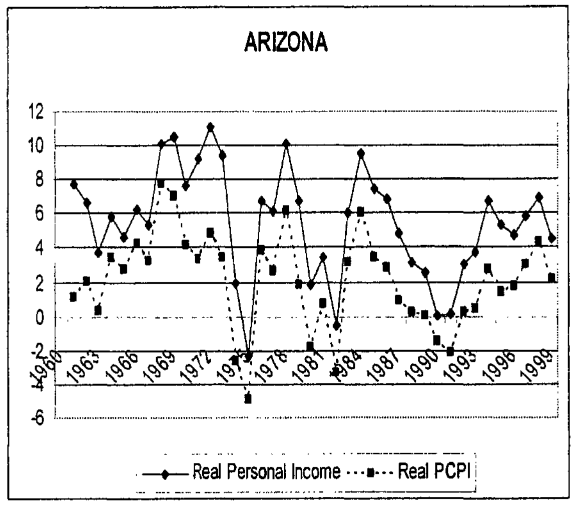
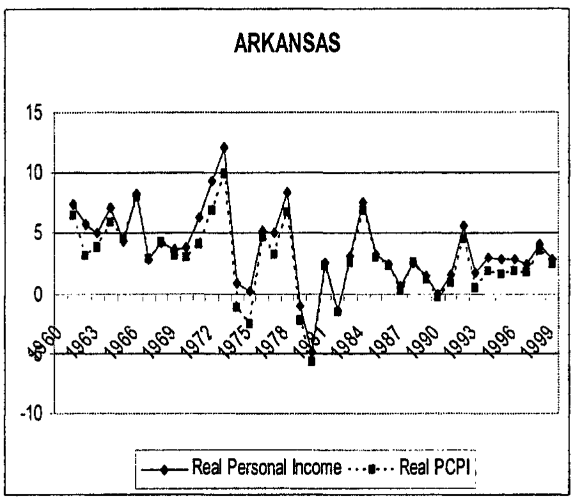
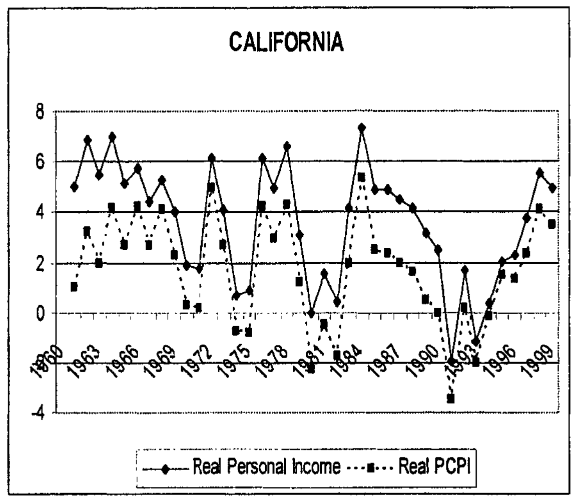
1996
1999

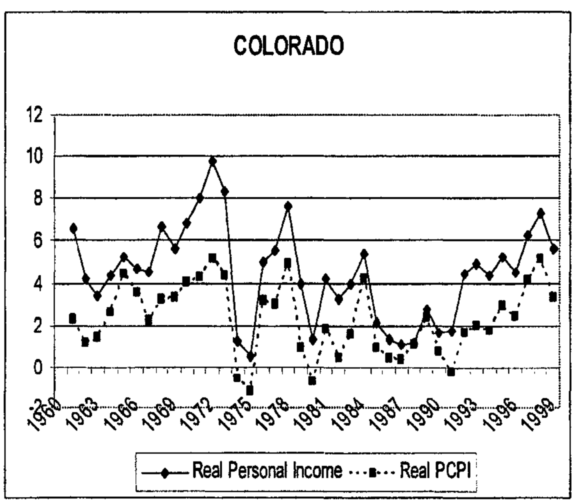
Appendix B: Individual State Time Series of Economic Growth Rates (percent): 1960-1999

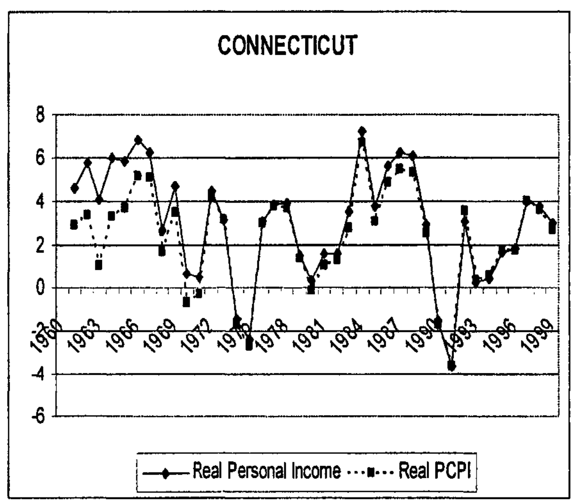












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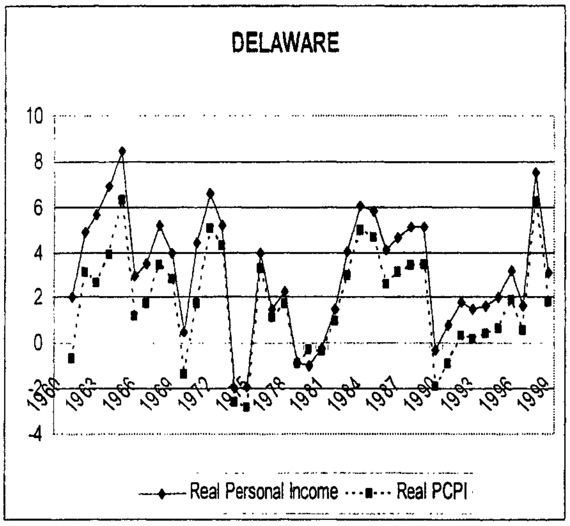
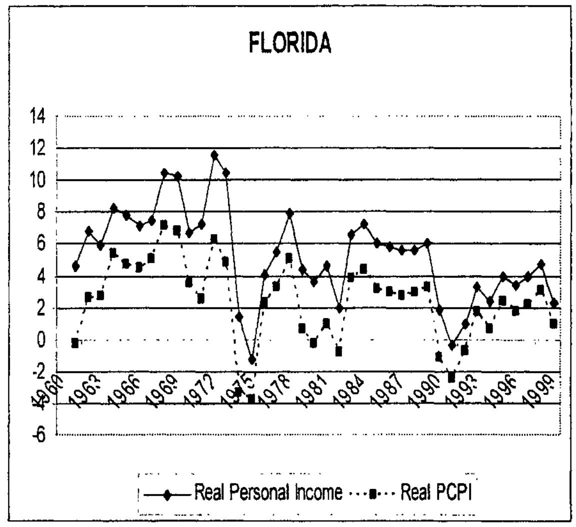
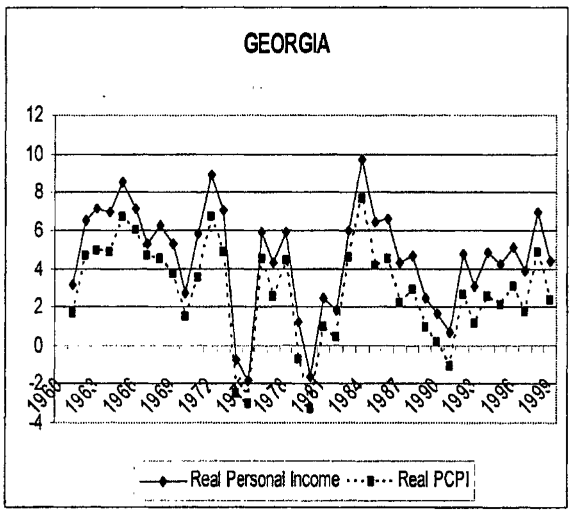
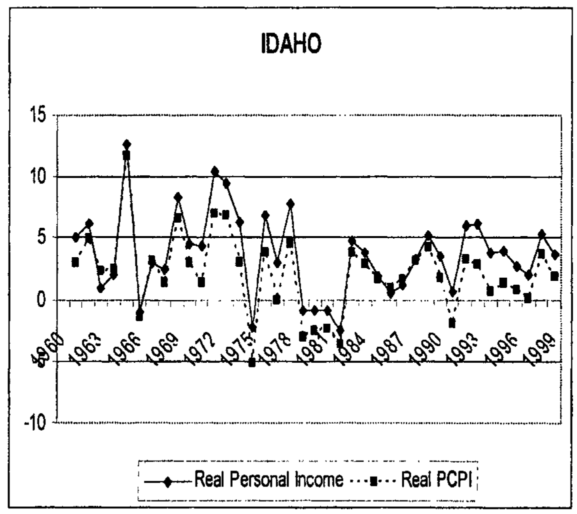
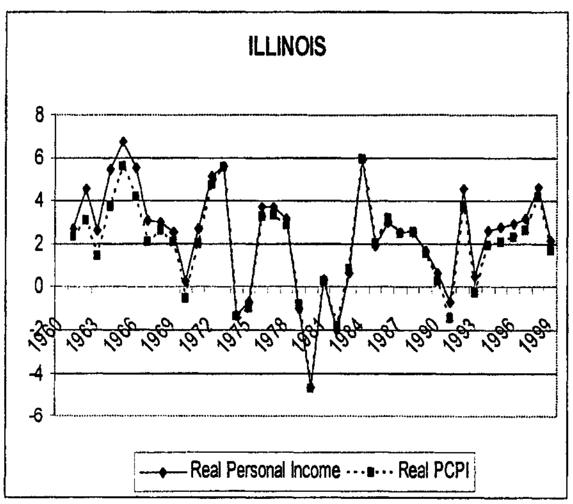
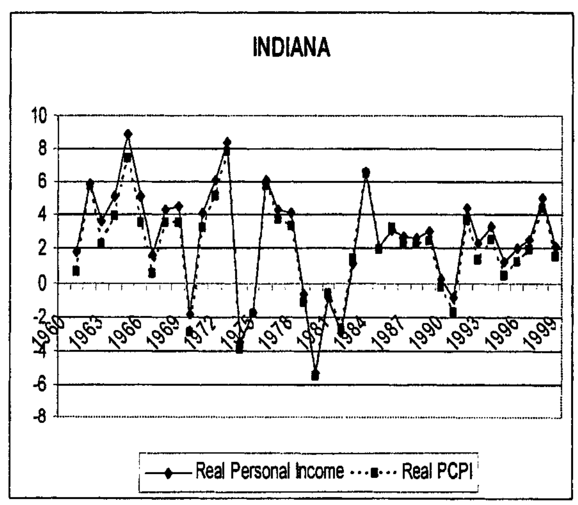

DELAWARE
Real Personal Income
Real PCPI


FLORIDA
Real Personal Income
Real PCPI

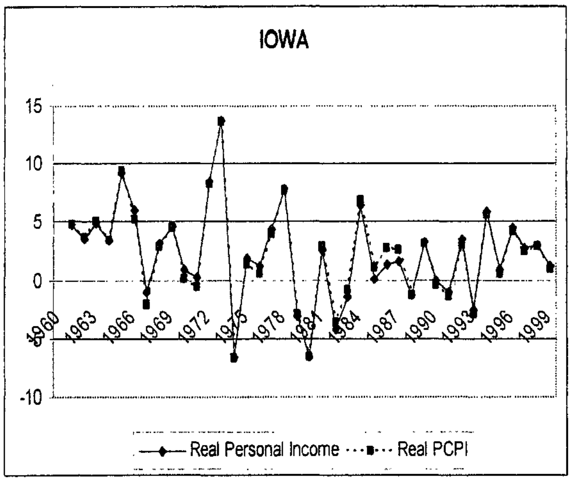

GEORGIA
Real Personal Income
Real PCPI

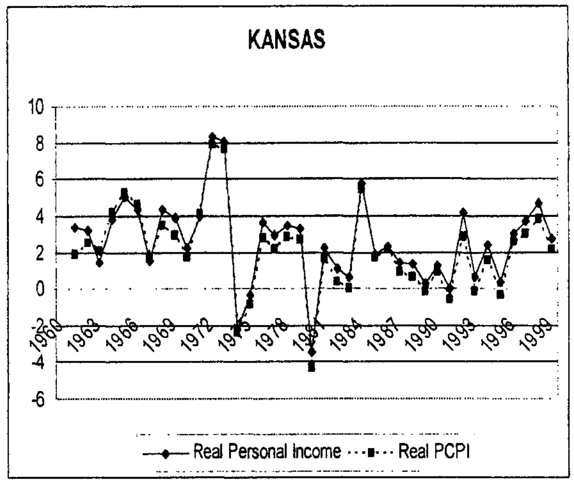

IDAHO
Real Personal Income
Real PCPI

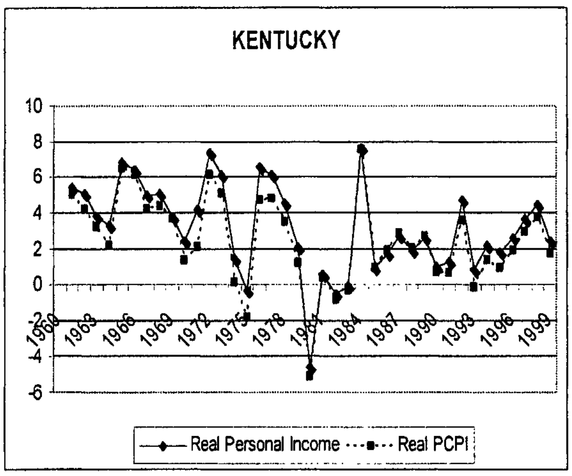

ILLINOIS
Real Personal Income
Real PCPI

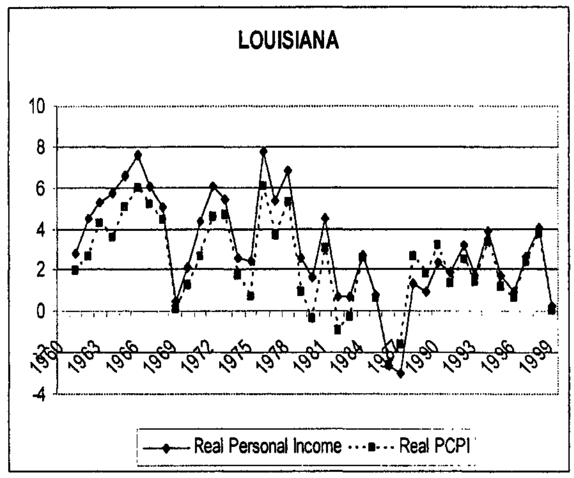

INDIANA
Real Personal Income
Real PCPI

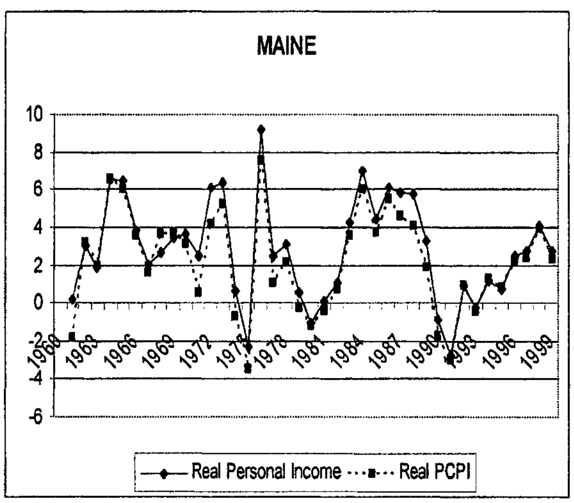
continued...

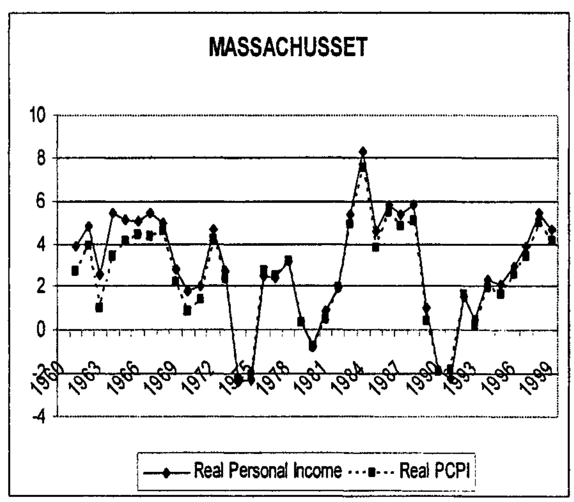

IOWA
Real Personal Income
Real PCPI


KANSAS
Real Personal Income
Real PCPI


KENTUCKY
Real Personal Income
Real PCPI


LOUISIANA
Real Personal Income
Real PCPI


MAINE
Real Personal Income
Real PCPI


MASSACHUSSET
Real Personal Income
Real PCPI

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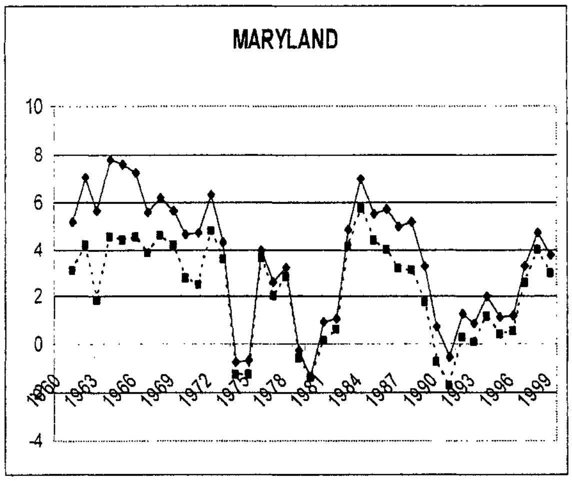
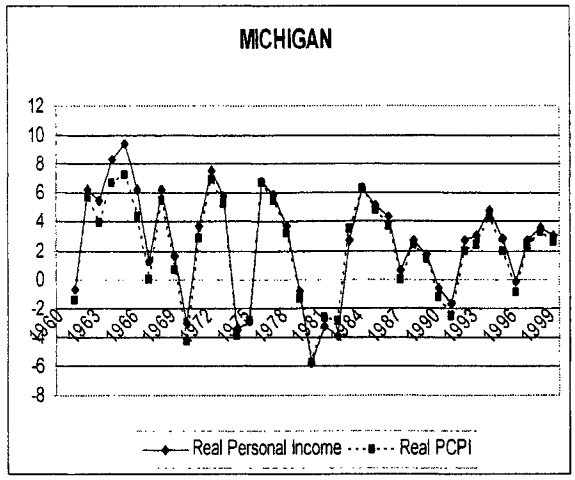
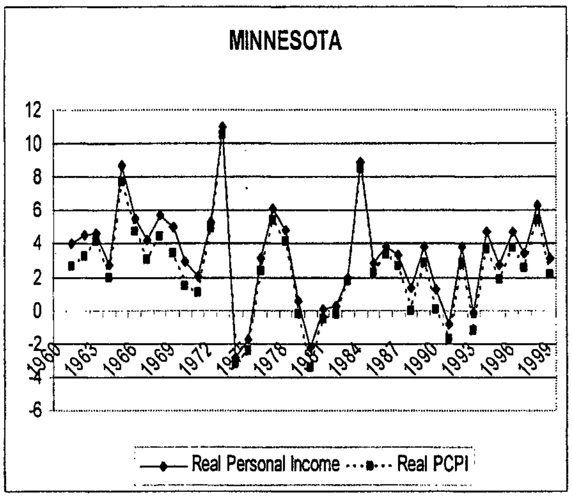
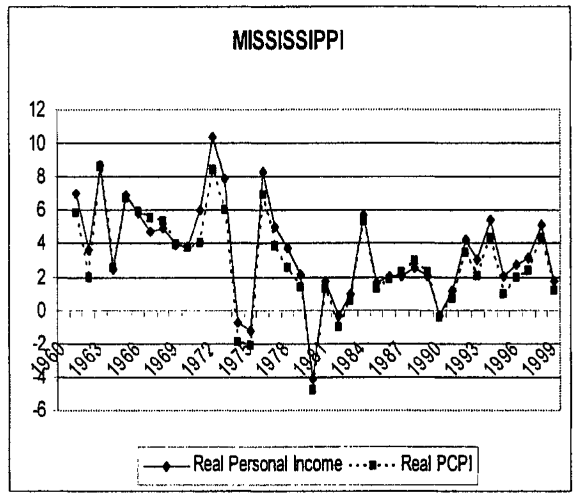
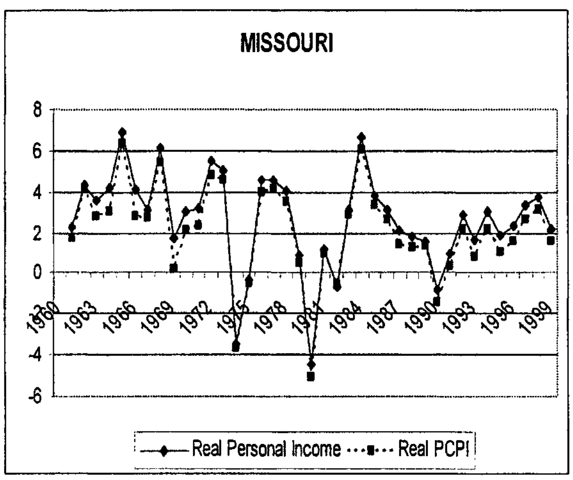
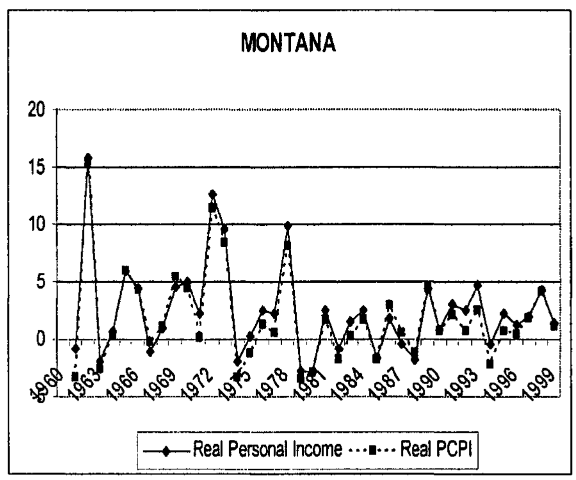

MARYLAND


MICHIGAN
Real Personal Income
Real PCPI


MINNESOTA
Real Personal Income
Real PCPI


MISSISSIPPI
Real Personal Income
Real PCPI


MISSOURI
Real Personal Income
Real PCPI


MONTANA
Real Personal Income
Real PCPI

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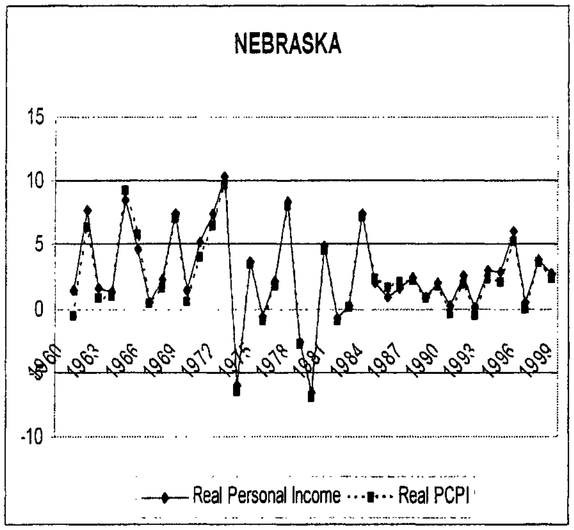
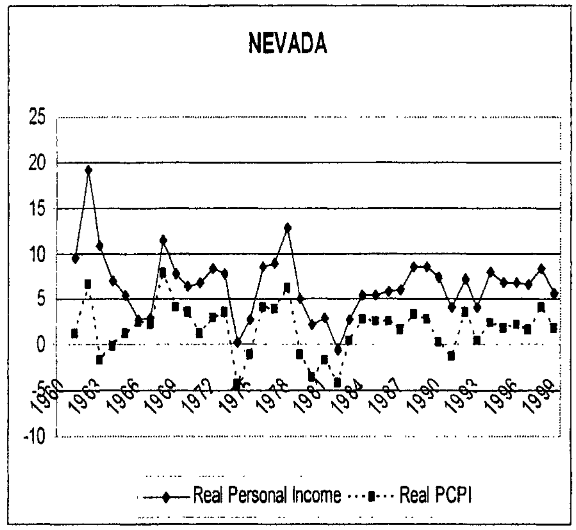
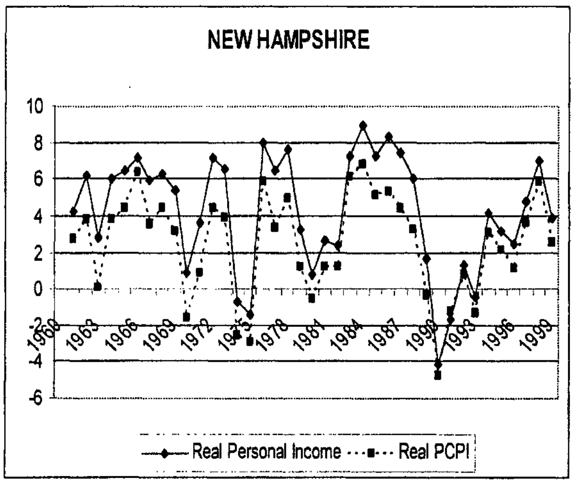
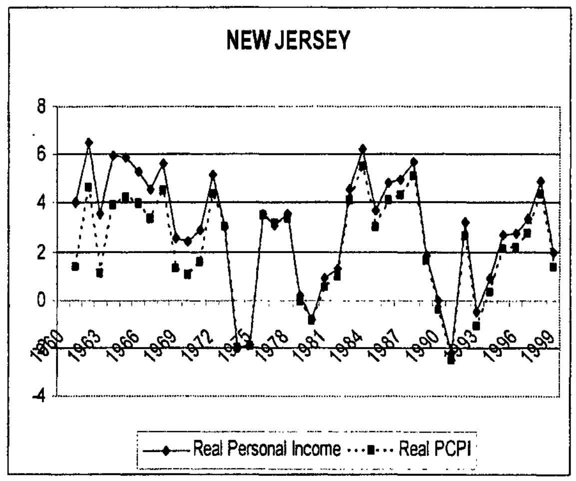
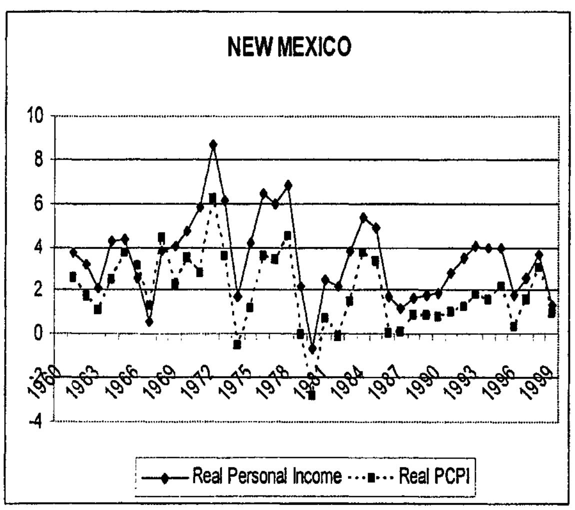
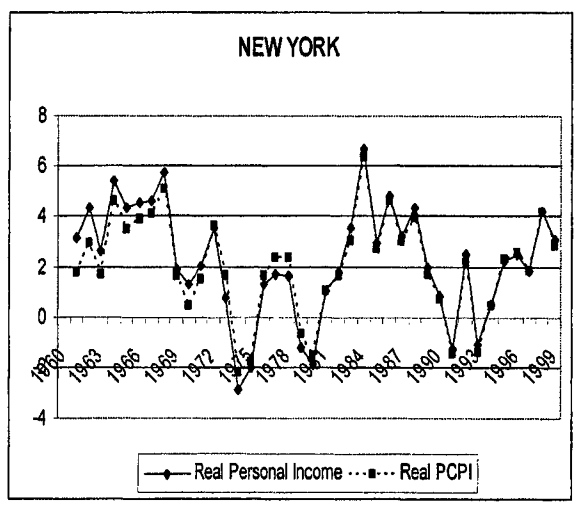

NEBRASKA
15
10
5
0
-10
Real Personal Income
Real PCPI


NEVADA
25
20
15
10
5
0
-10
Real Personal Income
Real PCPI

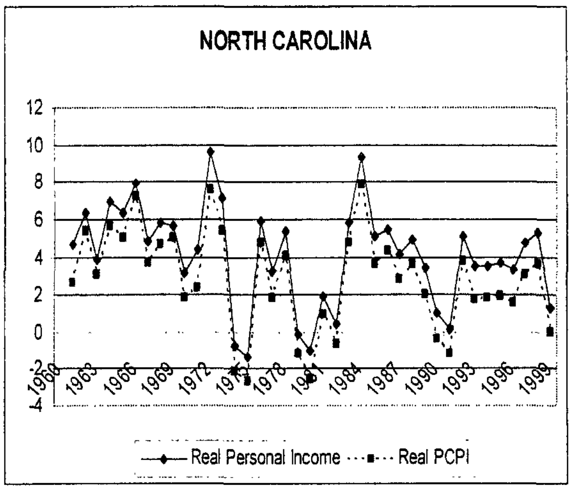

NEW HAMPSHIRE
10
8
6
4
2
0
-4
-6
Real Personal Income
Real PCPI


NEW JERSEY
8
6
4
2
0
-4
Real Personal Income
Real PCPI

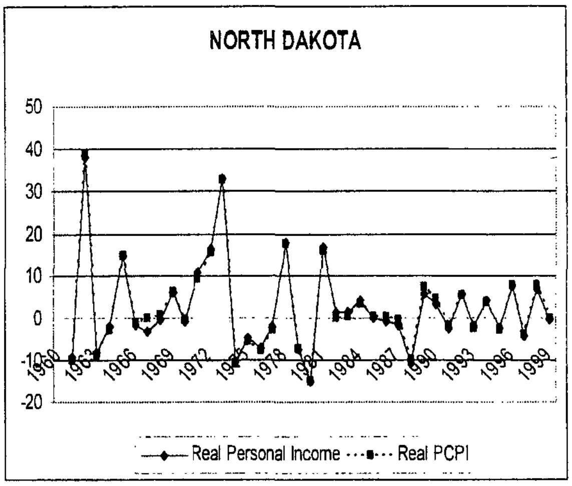

NEW MEXICO
10
8
6
4
2
0
-4
Real Personal Income
Real PCPI


NEW YORK
8
6
4
2
0
-4
Real Personal Income
Real PCPI

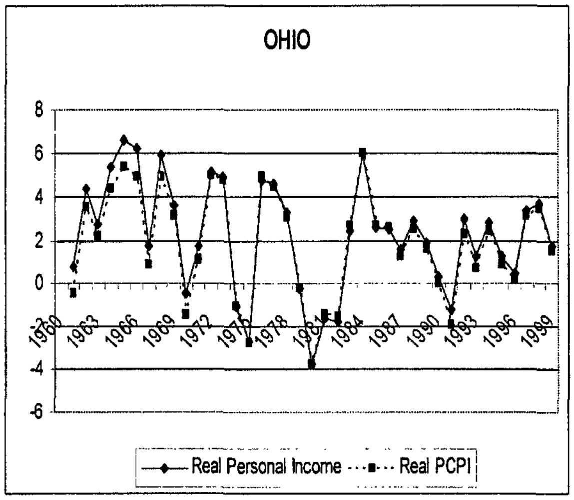
continued ...



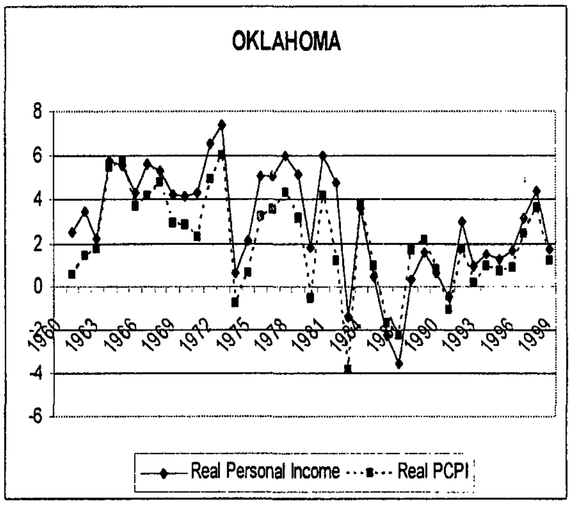
NORTH CAROLINA
Real Personal Income
Real PCPI



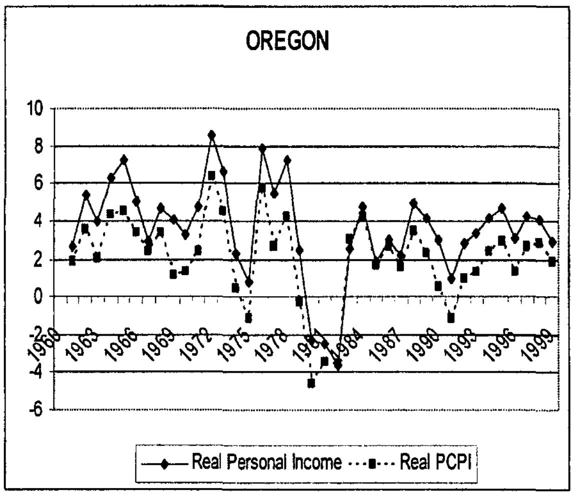
NORTH DAKOTA
Real Personal Income
Real PCPI



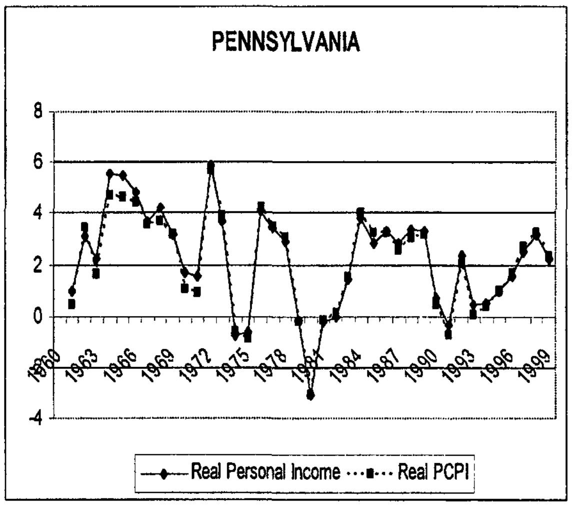
OHIO
Real Personal Income
Real PCPI



OKLAHOMA
Real Personal Income
Real PCPI

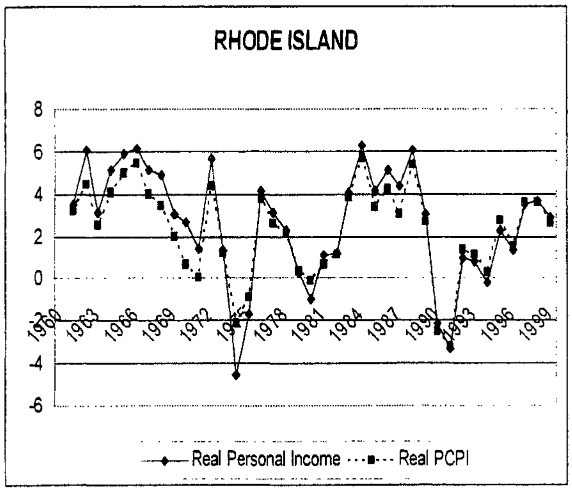


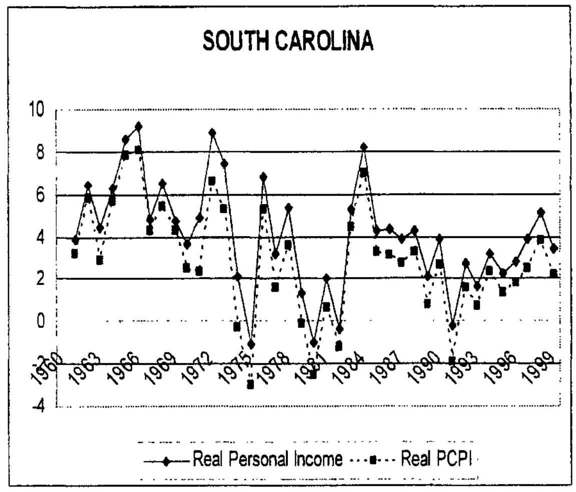
OREGON
Real Personal Income
Real PCPI

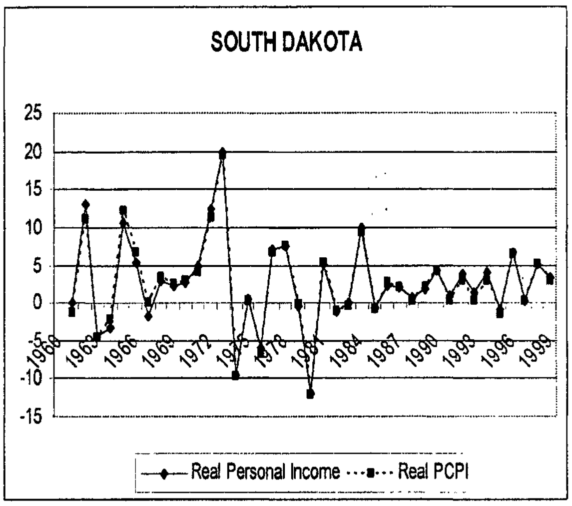


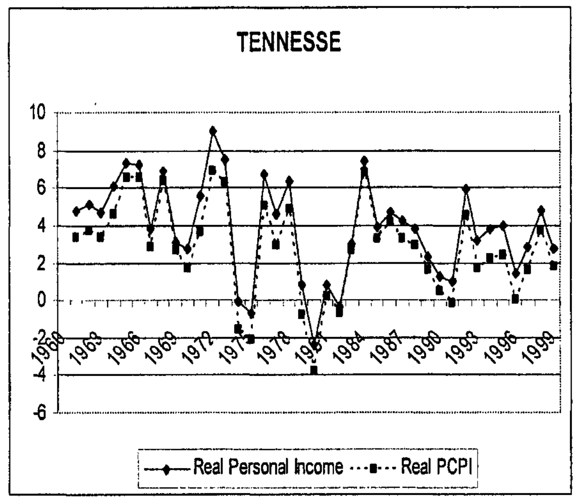
PENNSYLVANIA
Real Personal Income
Real PCPI

continued ...


RHODE ISLAND
Real Personal Income
Real PCPI


SOUTH CAROLINA
Real Personal Income
Real PCPI


SOUTH DAKOTA
Real Personal Income
Real PCPI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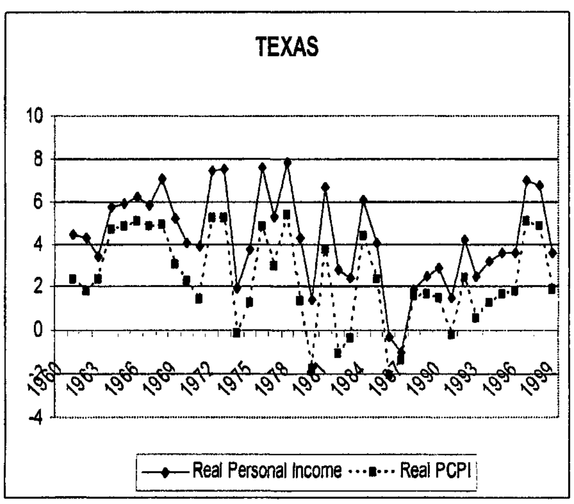
Real Personal Income
Real PCPI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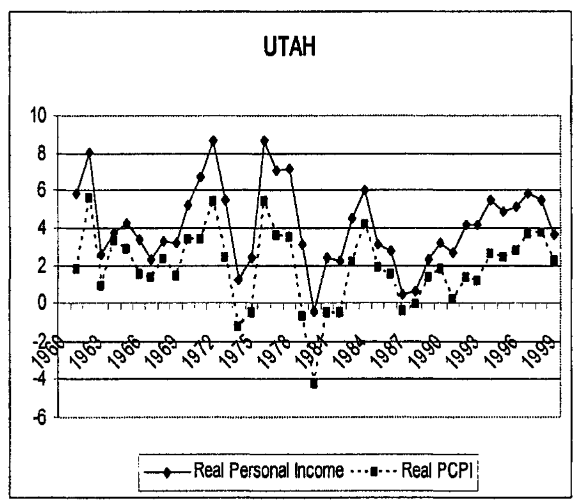
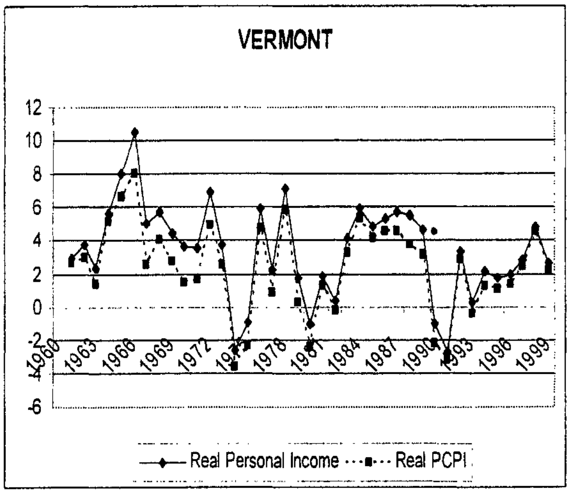
Real PCPI


UTAH
Real Personal Income
Real PCPI

continued ...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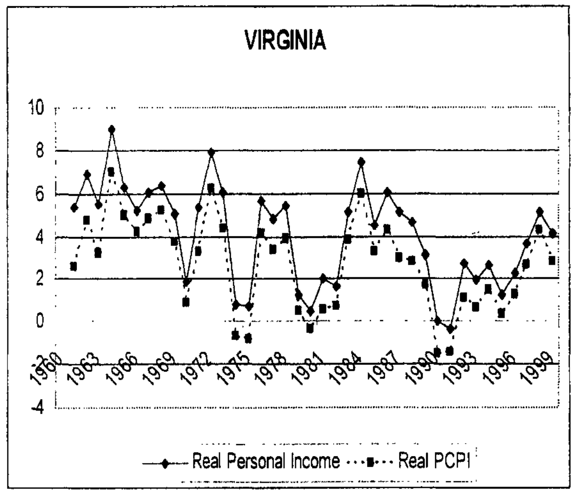
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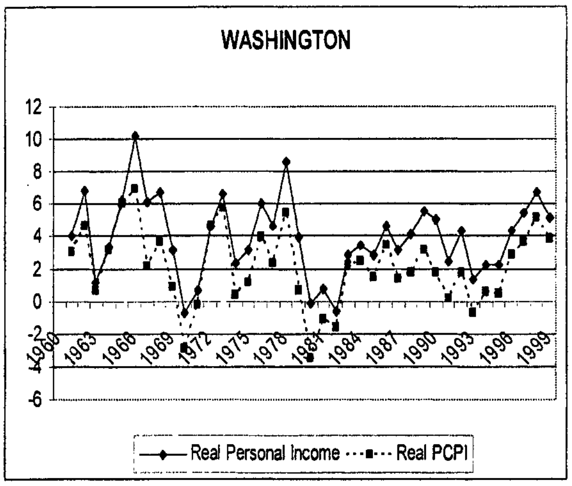
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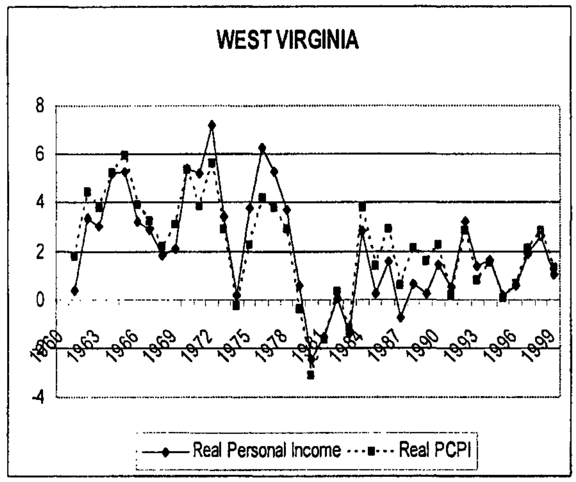
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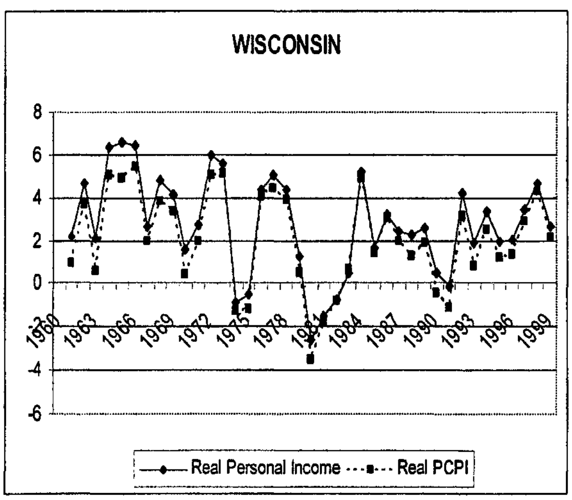
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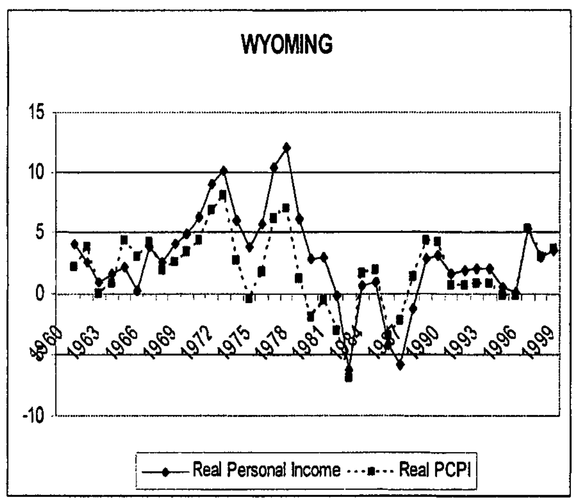
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Real Personal Income
Real PCPI

Appendix C: State Rank of the Average Economic Growth: 1960-1999

State	Average Growth[1]	Average Growth[2]	Rank[1]	Rank[2]
Alabama	3.228410	2.12371	23	23
Arizona	5.433853	2.70839	2	2
Arkansas	3.592924	2.22923	17	17
California	3.676129	2.27721	15	15
Colorado	4.526743	2.64993	5	5
Connecticut	2.987003	2.06376	27	27
Delaware	3.083541	2.09463	25	25
Florida	5.230317	2.67588	3	3
Georgia	4.551564	2.65527	4	4
Idaho	3.682596	2.35672	14	14
Illinois	2.344493	1.76591	43	43
Indiana	2.590044	1.87791	38	38
Iowa	2.229693	1.71593	45	45
Kansas	2.521011	1.83667	40	40
Kentucky	3.116827	2.10744	24	24
Louisiana	2.994961	2.07606	26	26
Maine	2.798994	1.97908	32	32
Maryland	3.609222	2.24733	16	16
Massachusetts	2.965735	2.01357	29	29
Michigan	2.493087	1.80736	41	41
Minnesota	3.341642	2.13435	22	22
Mississippi	3.430873	2.20908	19	19
Missouri	2.643171	1.92309	35	35
Montana	2.372772	1.79065	42	42
Nebraska	2.576810	1.87483	39	39
Nevada	6.504264	2.74365	1	1

State	Average Growth[1]	Average Growth[2]	Rank[1]	Rank[2]
New Hampshire	4.296901	2.60052	6	6
New Jersey	2.967495	2.02218	28	28
New Mexico	3.424795	2.20474	20	20
New York	2.249826	1.74278	44	44
North Carolina	4.144730	2.55462	8	8
North Dakota	2.674500	1.93894	34	34
Ohio	2.186772	1.64558	47	47
Oklahoma	2.929235	1.98744	30	30
Oregon	3.577140	2.22446	18	18
Pennsylvania	2.219872	1.64669	46	46
Rhode Island	2.596506	1.89628	37	37
South Carolina	4.047750	2.42362	11	11
South Dakota	2.616021	1.91048	36	36
Tennessee	3.802545	2.38193	13	13
Texas	4.284484	2.59559	7	7
Utah	4.090984	2.43818	10	10
Vermont	3.405537	2.17805	21	21
Virginia	4.091468	2.45030	9	9
Washington	3.893816	2.40608	12	12
West Virginia	2.063884	1.46263	48	48
Wisconsin	2.722506	1.94306	33	33
Wyoming	2.884893	1.98090	31	31

NOTES:

[1] State Real Personal Income
[2] State Real PCPI

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